MUSEUM BUILDINGS

LAURENCE VAIL COLEMAN

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MUSEUM BUILDINGS

By LAURENCE VAIL COLEMAN
DIRECTOR OF THE AMERICAN
ASSOCIATION OF MUSEUMS

Volume One *A Planning Study*

THE HILLA VON REBAY FOUNDATION
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GREENS FARMS, CONNECTICUT 06436

THE AMERICAN ASSOCIATION OF MUSEUMS
WASHINGTON, D. C. 1950

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WAVERLY PRESS, INC.
BALTIMORE, MARYLAND

FOREWORD AND ACKNOWLEDGMENTS

This book is for museum planners, whether they be architects, consultants, museum professionals, trustees, lay members of building committees, prospective benefactors, or others who set out to shape museum destinies through steel and concrete. The book is not a manual of architectural practice. It undertakes, instead, to be a review of experience with museum buildings put up since the time when museums became the rounded institutions they are today.

Some people, approaching this subject innocently, ask which building is the best to be followed. Fortunately there is no such best example, even of any one kind of museum building. An ideal scheme has never been even envisaged, to say nothing of being carried out. Every plan involves compromises between more or less incompatible objectives, and each project appears with its own unique set of only partly escapable frustrations. Thus museum planning cannot get into a sterile state—except perhaps by uncritical copying and recopying such as the present study is intended to forestall.

Many points in the text have been difficult to present because they touch different kinds of buildings in different ways. Art museums are given somewhat more attention than science and history museums because public art museum buildings make up the most numerous class, and have been subject to most experimentation and criticism. However, much of what is said about buildings of one or another kind has general application.

The present study, from the beginning of field observations to the finish of proofreading, has been carried out as a part of official duties with the American Association of Museums. Some of the writing was done in two summers spent at the MacDowell Colony, Peterborough, N. H.

The Carnegie Corporation of New York, though not in any way responsible for the result, has generously made the completion of this work possible through a special gift following its general support of the Association for years. President Charles Dollard and Secretary Robert M. Lester of the Corporation have shown long and helpful interest. Further, the individuals who have contributed to the Association's support during the past few years, especially those named in annual reports, have thus given valued assistance to this study.

I have so many people to thank for help freely given that I am powerless to make all the acknowledgments I should like to put on record here. I owe outstanding debt to at least a score of friends. Alfred Morton Githens, New York architect and co-author of a book on library buildings to which many references are made; Fiske Kimball, Philadelphia museum director, architect, and writer; Clarence S. Stein, New York architect who has written much on museums; Francis H. Jencks, Baltimore architect; and Henry H. Saylor of Washington, editor of the *Journal* of the American Institute of Architects, have, all of them, been extremely kind in advising on many a matter. Also Sterling P. Eagleton, superintendent of the National Gallery, L. L. Oliver, superintendent of the National Museum, and R. P. Johnson, superintendent of the American Museum, have responded most helpfully to numerous inquiries of mine.

For engineering counsel I am deeply indebted to Ward Harrison, director of engineering, and Matthew Luckiesh, director of the Lighting Research Laboratory, both of the Nela Park Engineering Division of General Electric Company, Cleveland. James M. Ketch of the Nela Park organization,

Frank H. Faust of the Air Conditioning Department of General Electric Company, Bloomfield, N. J., and Victor J. Richter, consulting engineer of Silver Spring, Md., have most graciously read considerable parts of the manuscript coming within their fields and have offered criticisms from which technical chapters have profited not a little. Henry L. Logan, engineer of the Holophane Company, New York; Blair Childs of the H. H. Robertson Company's Washington office; and E. W. W. Hoyt of the Michaels Art Bronze Company, Covington, Ky., have also given special advice for which I am grateful.

The drawings that illustrate the text and hundreds of others to be reproduced later on as plates are the work of George T. Petsche, able draughtsman who has devoted himself unstintingly to this task for many months. A few drawings for plates have been prepared by Joseph T. Gaiser and Carl J. See, both of Washington also. Most of the photographs that are reproduced or are still to be published have come from the museums they represent, and several of them, through great kindness, have been taken expressly for this purpose. Photographs of museums in national parks have been made available by the National Park Service.

This record of thanks would be incomplete without an expression of warm tribute to my friend David E. Finley, director of the National Gallery and past president of the American Association of Museums, whose interest has backed this study through years to the moment of its appearance.

L. V. C.

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MUSEUM BUILDINGS

CHAPTER I. PRESENT-DAY BUILDINGS

The nineteen fifties will be critical years in the history of museums. They are destined to see building activity renewed, and this at a time when the planning and construction of museums can profit vastly from experience. During the interwar decades, roughly the 'twenties and 'thirties, museums grew and multiplied as never before, and a deep-seated change came over architecture itself. Then during the ensuing war and postwar decade, the 'forties, public works were practically at a standstill and there was a chance for scrutiny of the earlier work and for reflection upon it. Now museums have the opportunity, in fact they face the necessity, of making a truly dramatic choice between learning finished lessons over again and, what would be better, continuing sound advance in the light of lessons learned and in the spirit of today.

The formative period of construction extended, to be exact, from 1916 through 1942. This was from the completion of the first building rationally planned for what would be called today a full-fledged museum to the completion of the last prewar museum structure. Taking 1916 as the year of beginning means leaving behind a whole century of effort in museum design; but this does not detract from the importance in their day, and also historically, of certain buildings that are no longer useful as examples. Nor should it overlook enduring values of some early studies focused on Europe and having to do for the most part with natural lighting and arrangement of exhibition space—the best known being the studies made in preparation for the still notable 1909 building of the Museum of Fine Arts, Boston. But buildings realistically planned for the whole organism known as the present-day museum, with the many familiar provisions for operation and public service in addition to improved curatorial and display facilities, appeared from the time of World War I onward. The oldest is the art museum at Cleveland, which ushered in the new period with its opening in 1916; and among other early examples are a general museum at Newark, completed in 1926, and a science museum at Buffalo, 1929. To be sure, many older buildings have taken on new character through additions and remodeling, but the up-to-date sort of museum plan has been a creation of quite recent years during which the now familiar complex of museum functions has, itself, developed.

The formative years of museum building, so defined, fall into two groups that are very different with respect to what they brought forth. These periods are from 1916 through 1932, and from 1933 through 1942. The earlier group of years produced museums in the old eclectic spirit of architecture. Buildings of that time—nearly 90 million dollars worth of them—made use of styles of the past, and were commonly of adapted Renaissance or Neo-Classical style. The later years, from 1933 on, showed a general turn to contemporary style. Only two or three museums, notably the West Coast art museums at Seattle and Portland, both completed in '32, were recognized forerunners of the sweeping change in architectural treatment that came in 1933. During the decade thereafter, more than 66 million dollars went into museum construction—some of it, to be sure, into expanding older and outmoded buildings, and some into putting up new buildings conceived in the older way, but a large share of it into building modern museum structures.

MUSEUM OF MODERN ART, NEW YORK, N. Y. PHILIP L. GOODWIN, ARCHITECT; EDWARD D. STONE, ASSOCIATE

The general adoption of modern style was evidence of a fundamental change in architectural purpose and method that became apparent somewhat earlier in other branches of building but that did not take hold of museums until the 'thirties. This involved rejection of the formal dictates of styles handed down from the past, in favor of fresh consideration for needs of today and efforts to serve these needs creatively in the light of contemporary aesthetic ideas and with the help of modern means. For museums, the most obvious part of the change was the virtual disappearance of the temple form, with its colonnaded porticos and long flight of approaching steps; of the church form, with its borrowed temple members, and its piers, arches, vaults, and dome; and of the palace form, with its balanced plan, its formal staircase, and perhaps its cloistered court or colonnaded halls. For these stylistic forms, born of bygone purposes and carried out in semblance of bygone ways, were substituted clear expressions of present needs, employing steel, concrete, glass, and other materials, including stone, in up-to-date construction, recognizing modern developments in mechanical, illuminating, and heating and ventilating engineering.

The decade from 1933 to the close of prewar construction in 1942, saw only four new public museum buildings put up in accustomed Classical style and not a single one in Renaissance style; but it brought forth some 50 modern buildings including those of a score of important public museums. This leaves out buildings of early American types, most of them for small museums of history; it leaves out one building of Mediaeval type designed for The Cloisters in New York; and it leaves out little rustic structures of no particular style built for trailside museums in national and state parks. Also it disregards many enlargements of older buildings that were carried out in keeping with existing parts. But in other respects the recent record stands in sharp contrast to what happened in the years from 1916 through 1932, during which well over a hundred public museum buildings were put up in Neo-Classical, or adapted Renaissance, or other revival style, and with corresponding arrangements.

Let us note at once that the change in treatment, which implied new freedom for the meeting of practical needs, did not in some cases hold fast to practical gains made under the older regime. Many buildings completed before the early 'thirties had been studiously planned for use. To mention the Cleveland Museum of Art, the Freer Gallery of Art at Washington, the Detroit Institute of Arts, and the Fogg Museum of Art at Harvard University, about which so much has been written, is but to neglect other important art buildings of that time; and, similarly in other fields, it would be incomplete to single out the Newark Museum for its planned flexibility, the Buffalo Museum of Science for its recognition of many functions, the Field Museum (now the Chicago Natural History Museum) for increased space assignment to curatorial work, the university science museums at Yale, Chicago, Michigan, and Nebraska, and the public museums of history at New York and Chicago for various other good points. Further, any such review would neglect some meaningful additions to older structures—one example, the school-service building of New York's American Museum. In contrast to such progressive buildings of earlier years, there are later, modern-looking buildings of the 'thirties that actually deny the modern spirit by failing to pay even ordinary heed to museum requirements. However, this need not be surprising in the initial stage of a far-reaching change, and certainly it should not obscure the fact that the new developments hold great possibilities for rational planning and creative expression. Retrogressive recent buildings, whether they look modern or not, are reminders that for museums the years ahead are important years of decision.

Present indications seem to be better than hopeful. The first postwar building, Saarinen's of 1948 for the Des Moines Art Center, is a worthy modern. All the known plans for new buildings contemplate modern types; and even state architectural bureaus, long tenaciously backward-looking, have come up with some strikingly progressive projects, witness Illinois and Indiana. Moreover, some of the museums that have uncompleted old buildings are already on record as proposing to carry out future plans in modern style.

The best museums of the final prewar decade—the modern decade—of construction are most of them well known. After forerunners at Omaha, Seattle, and Portland,

COLORADO SPRINGS FINE ARTS CENTER, COLORADO. JOHN GAW MEEM, ARCHITECT

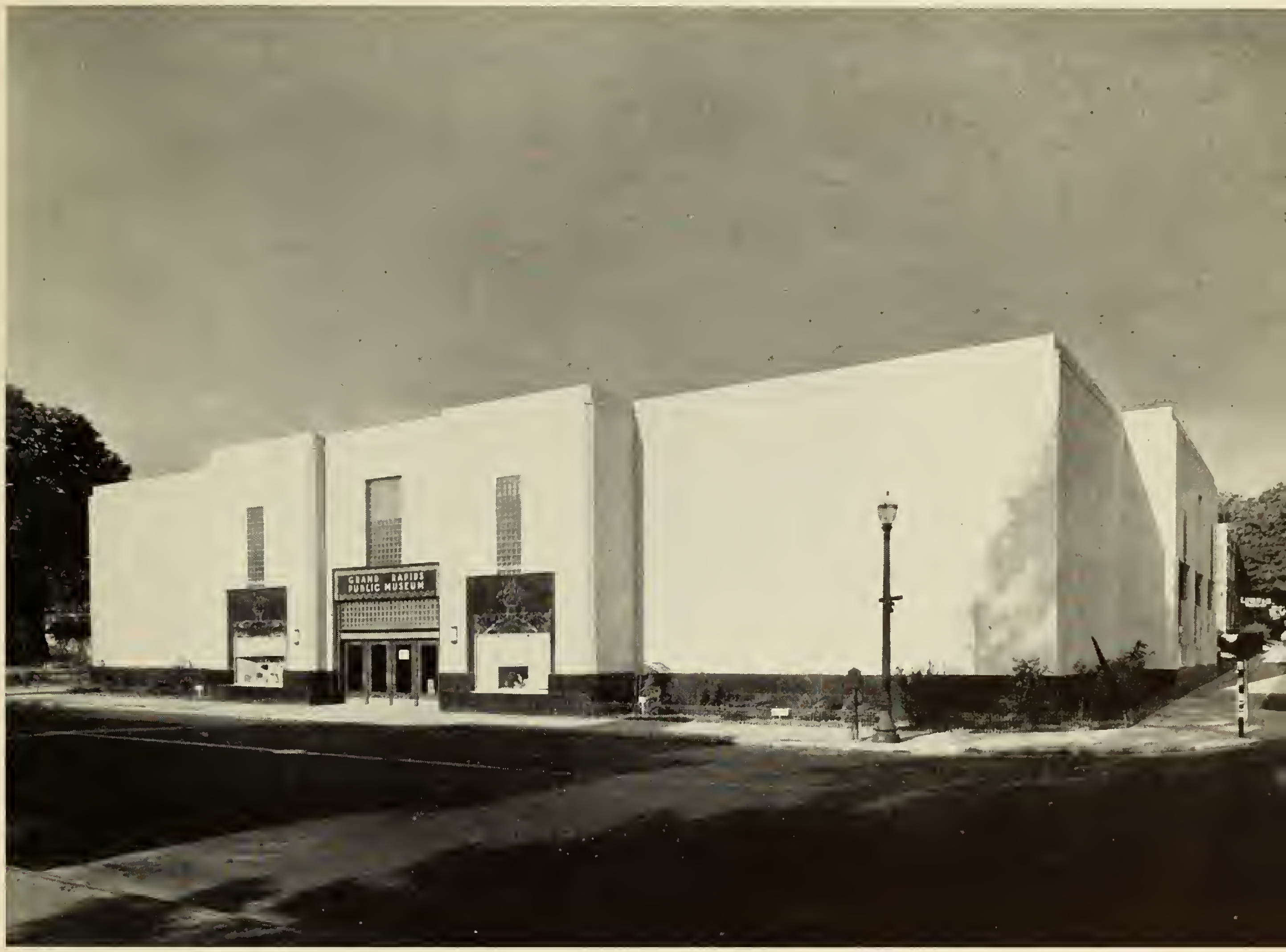
came a series of modern art museums including, most notably, Hartford's Avery Memorial, the Colorado Springs Fine Arts Center, the Dallas Museum of Fine Arts, New York's Museum of Modern Art, and the museum of the Cranbrook Academy of Art in Michigan. Science also made a showing of moderns including the Cranbrook Institute of Science, the Grand Rapids Public Museum, the Rochester Museum, the Minnesota Museum of Natural History at Minneapolis, and several planetariums. Meanwhile, contributing to the record, came some notable efforts at remodeling old buildings to the partly modern—as with the Brooklyn Museum, the New York Historical Society, the Chicago Museum of Science and Industry, and the Natural History Museum at Springfield, Massachusetts.

By the time modern style had become well established, the only four Neo-Classical museums of the modern decade had also been completed. The last of these, the greatest of its kind, is the National Gallery of Art at Washington; the other three are the Nelson Gallery of Art at Kansas City, the San Francisco Museum of Art, and the Franklin Institute, an industry museum, at Philadelphia. Judging from the changes that have come over museum practice and architectural work and education, it seems quite unlikely that other buildings of this type will be put up in the future.

MODERN FEATURES, which characterize recent museums as a class, are not all of them wholly new. Some have appeared rather as tendencies, emerging from decades of growth and lately released for further development by the advent of modern style. Other features are unmistakably new, marking decisive advances in thought and action that are part of the recent change.

The most familiar of the present-day features is one that has come step by step. This is full provision for efficient work of the staff. One need only recall the older kind of building designed almost wholly for exhibits, to appreciate the individuality of the present type with its conveniently placed administrative offices, curatorial rooms and live storages, a library reading room and stacks, a well appointed auditorium, rooms for class work, facilities for lending to schools, a place for receiving temporary shows and for unpacking, registering, packing, and shipping, a superintendent's office, a photographer's laboratory, a printshop, artisans' studios and mechanical shops of different kinds, accommodations for the manual force and labor, and an up-to-date mechanical plant. Some museums have proportionately more than others of such specialized provisions; but every museum is advanced or archaic according to whether or not it provides realistically for its workers and their work.

Another deep-rooted development is the extension of ways in which the public's point of view and convenience are considered. There are some examples of sidewalk display—the earliest at Grand Rapids. The main entrance tends to be at sidewalk level. The lobby is more spacious and is now made to function effectively as a control room. It has checking facilities, seats, and telephones, and it communicates with rest rooms, a lounge, and perhaps a public restaurant. The public information desk is growing into an educational booking office; the sales desk is becoming a bookshop; and there are signs that space near the lobby will become a characteristic new place for contemplation, reading, and orientation to the exhibits. Exhibition space begins as a rule at the main entrance level. A place for temporary exhibits tends to come first; and space for permanent exhibits, not



GRAND RAPIDS PUBLIC MUSEUM, MICHIGAN. ROGER ALLEN, ARCHITECT

far away, is arranged so that any main part can be reached without going through other parts. Also in some museums the exhibition space is arranged for division of permanent exhibits into what is primarily for the casual visitor, arranged in sequence of time and place, and what is primarily for the special worker, arranged in systematic, technical or analytical order.

A conspicuous feature of nearly every recent building is the larger use made of artificial lighting. This change is important in itself, and perhaps even more important on account of its relation to the organizing of space within the building. Good illumination is now a daytime as well as an evening matter; the architect and the engineer are expected to cooperate toward making a day-worthy building, and in so doing they meet the needs for hours of darkness also. The effect of up-to-date lighting on the basic work of the planner, in the organizing of space, has been felt most by art museums because they happen to be relieved by the recent developments from a very serious deadlock long imposed upon them by skylights. Their earlier difficulty came from the necessity of having the main exhibition floor, with its skylights, at the top of the building, thus inevitably crowding all non-exhibition functions into the space below. Science and history museums, because they rarely use skylights, have been able to pile up four or five stories at will, putting curatorial space at levels above exhibits; but even these museums have lacked freedom in arranging their exhibits because of crudities under old conditions of lighting. Through skilful use of artificial lighting, on a larger scale than before, museums are now able to follow practical promptings in not a few matters of planning that always used to be settled before the planning began.

Another strongly formative change is the adoption of air conditioning, which gives the planner still further chances for untrammeled arrangement of space, to say nothing of making museums more efficient in their work and more agreeable to the public. Twenty years ago there was not much of even simple forced ventilation, and ten years ago ventilation meant only filtering, preheating, and circulation of air, but today a new public museum that does not have year-round control of both temperature and humidity may be regarded as a backward establishment. We have come to realize also that workrooms need conditioning as much as public spaces. And, although many small buildings and also some large buildings of recent date do not make all these provisions, it seems to be recognized now that a new building should have ducts designed for both winter and summer conditioning, and space to take the corresponding equipment, even though the mechanical plant may be only partly complete when the building is opened to the public.

A development of paramount importance, unevenly advanced though clearly in the making for all museums, is adequate and rightly designed provision for live storage of collections and for the related business of reference and research. Storages are not new; science museums have long had space, whole floors in the big museums, for study collections; and art museums have had storerooms at least for paintings, although often they have had to make the best of basement space or some other ill-adapted and inaccessible part of the building for this purpose. Curatorial facilities in close relationship to exhibits, where they exist at all, have been products for the most part of remodeling. Indications now point to acceptance of the idea that *enlargeable* space for study storage is an initial requirement of every well designed museum. In fact, modern plastic organization of space now makes possible a strikingly new arrangement that seems likely to characterize museums of the future. This is a combination of a horizontal exhibition block of one or two floors near the ground with a vertical curatorial block rising several stories higher from only a part of the ground plan. Under the Classical regime, such an organization would have been unthinkable.

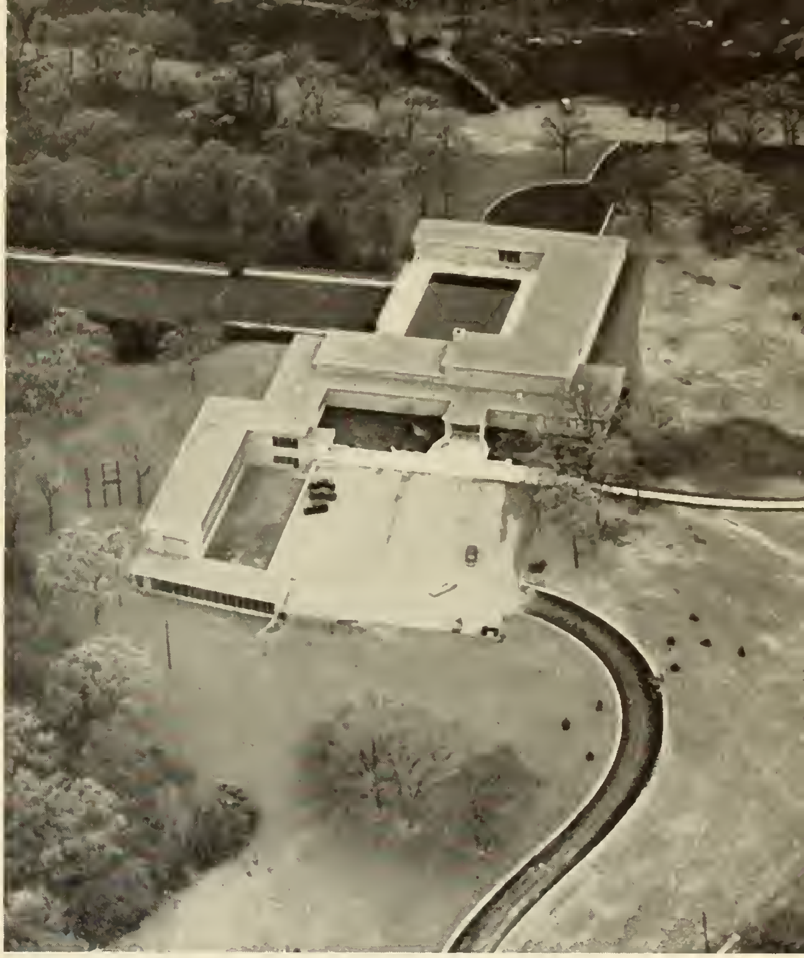
Several other new characters of not a little collective importance have come from the designer's added freedom. Perhaps most obvious of these is the transformed assembly place. The lecture room, which used to be a mere allotment of space within the walls of the building, is becoming a unit of enough architectural importance to form a main element in the building's composition of masses. This result, in a small building, is seen at the Colorado Springs Fine Arts Center that has a stage box rising from its tasteful grouping of volumes designed with regard to their uses. The auditorium desirably has two approaches the one passing right or left from the main museum lobby, and the other cutting into this route to provide a separate entrance for times when exhibits are closed. The Minnesota Museum of Natural History shows this arrangement in a diagrammatic manner.

Similarly there have been evolved, in some of the new buildings, units of volume that are shaped by the library reading room and stacks, or by classrooms, or studios, or shops, or administrative offices, and of course by exhibition spaces themselves. The results are notably different from the results of dividing a compact space into rooms in the traditional way. The Des Moines Art Center shows this with great clarity.

A special place for music has been provided in many museums, as at Toledo with its full-scale museum concert hall, at Colorado Springs with a separate music room, and and at some other places that, like New York's Frick Collection, have made arrangements for music in a lecture hall. But there is a tendency to seek informal surroundings for music. The Cleveland museum began this long ago with organ recitals in its garden court, and of late the National Gallery has used one of its garden courts in preference to its auditorium although at real disadvantage in seating the audience. There seems here to be a point for the future since an informal setting can be workable in its arrangements and acoustically good without loss—in fact, with gain—of charm.

Flexibility of the building to allow for readjustments is another feature that now receives attention. Few museums are as yet prepared to reset partitions for a new temporary show, as the Museum of Modern Art in New York can do with all completeness; but many museums have this kind of flexibility in a measure, and planners tend to allow for dividing space by installations of exhibits rather than to partition space rigidly with walls. Even in some rather rigid-looking buildings, rooms are formed with non-bearing walls that can be relocated; and there is commonly a uniform module for construction, ducts, and wiring. Walls are increasingly plain, and unbroken by architectural or structural features. Work spaces, whether curatorial, educational, administrative, or technical, tend to be given still more tentative organization.

Flexibility of the kind that allows for functional growth—that is, expansion of the various categories of space without violence to either the appearance of the building or its usefulness—has been envisaged in some recent buildings, neglected and then loudly cried about in others. Unless the growth of a building is planned wisely from the start, additions have to be sadly improvised. Shortness of funds may dictate an incomplete building, but only shortness of sight can give a hidebound project.



DES MOINES ART CENTER, IOWA. ELIEL AND EERO SAARINEN AND SWANSON; AND BROOKS-BORG, ASSOCIATED ARCHITECTS

There is no one *parti*, or general scheme of arrangement, that can be singled out as the emerging preference. Several lines of evolution are plainly observable, the site being the controlling factor as a rule. Hemmed-in city plots may force their buildings to extend upward. More spacious city sites may prompt both vertical and horizontal development; and here modern style gives great advantage, as we have seen, by putting aside the formal plan and profile in favor of freer design. Large landscaped sites, especially on rolling land, encourage spreading out at one or two levels, and may produce an advantageous nodal plan that admits of extension by adding of units to a group. Nodal buildings are not new; the little Santa Barbara Museum of Natural History and the great American Museum of Natural History, to name only two, have so developed for years. But satisfactory arrangements in composition of units is characteristically within the modern program.

Community relations and public support have exerted a centripetal pull upon museums, so that sites in remote parks are now outside the pale. Public museums seem in general to fare best if located centrally from one of the larger residential sections. Neither an outlying tract nor a plot right at the business center is ordinarily considered as good as an accessible but not too crowded piece of land on one of the connecting routes that large numbers of people follow regularly in their daily living. Exceptional cases, to which these observations do not apply, are less common than they used to be.

The many changes that have come over museums are results, more or less directly, of improvement in the usefulness and standing of museums. Never before have these institutions meant so much to the people for the services they perform and the ideals they embody. Europe's destruction of cultural treasures, and of agencies that protect them and give them meaning, has had the effect of putting vast emotional force behind the rise of museums. Museums have always advanced after times of adversity; and now, reacting to the years of retardation during the war, museums are again ready for growth. In the building sector, where crowding has by now created physical pressure, the way seems very forcefully prepared. Soon there should be a record burst of good museum construction.

NEW BOSTON MUSEUM OF SCIENCE, AS PROJECTED BY AMES, CHILD AND GRAVES, ARCHITECTS

CHAPTER II. THE MUSEUM ORGANISM

The museum is a sort of creature for which the museum building is the supporting structure and covering. A good building fits its occupant and provides for natural action; and it ought to have ways of being enlarged as the occupant grows.

Museum people take for granted that their work will go on regardless of surroundings, but without proper housing they cannot do the job as they should. A functional staff is better than a functional shelter for it; but the shelter is none the less important in making the staff effective. The future of museum work in all its branches rests heavily on the character of future museum buildings.

For a survey of the different kinds of museums, their aims, their work, and their problems, reference is made to the author's three-volume study, *The Museum in America*, published in 1939 by the American Association of Museums. No attempt is made here to recanvass this ground in taking up a few points as they bear on the planning of buildings.

Museum fields, which are broadly art, science, and history, are cultivated as a rule in such different ways that no one museum, unless it be in effect a group of separate institutions, can well deal with all these fields together. Even for a great city this is so, and for a small community it is many times more true. Experience shows that where there is not enough support for two or three museums, the best plan is to start a good museum in the field that has most support, letting the future take care of other fields. State museums are exceptions because they are logically responsible for both science (especially as applied to natural resources) and history, and this double duty gives them two claims on anthropology as well.

Anthropology is a border-line subject. It appears in both history museums and science museums because its materials are objects of culture history on the one hand and are commonly dealt with by scientific methods on the other. Also, in fact, some of anthropology's materials are objects of art. The treatment of the subject in each setting should be distinct, so that inclusion of anthropological objects should not break down the strict character of any museum. There are some special museums of man that take in several aspects of one or another culture, perhaps of some aboriginal group, perhaps of a modern nation. Carried out successfully, this plan yields not a general museum in the ordinary sense but rather a new kind of museum that is refreshing in its living concern with arts and crafts of a people as well as with the scientific and historical knowledge of them. Many of the American Indian museums, especially in the Southwest, are of this kind.

Industry is another border-line subject that has brought forth museums of a special kind. In one way industry is part of history, and in another way it is science applied, or technology. Small industrial collections have been formed by many history museums; but science and industry museums, as some industrial museums have come to be called, are typically big institutions reflecting the contemporary scene and located in the principal cities. Only two, those of Chicago and Philadelphia, have buildings (not overlooking a building at Dearborn for history of industry, and part of a company building at Worcester).

Art, science, and history museums have found different ways of being significant and useful without amassing more material than they can handle. Art collecting is by nature selective, and an art museum takes on some importance if it acquires even a few worthy objects of any time or place; the present time and the local place have growing shares of attention, and there are also specializations in one art, as for example Oriental art, or in one medium, as for example textiles, or in the art of one man, as that of Rodin. Science collecting is by nature illustrative, relating to abstract points; local collecting gives the most practical means of concentration. For some unaccountable reason special museums of one branch of natural science, such as entomology or ornithology, scarcely exist. History museums are by their nature geographically special; as a rule the emphasis in each museum is on the home county or state. Sometimes this tends to bring about a subject specialization, prompted by an erstwhile or present local interest such as pioneering or mining in the West.

The museum that builds without knowing exactly how its field is defined, is getting off on the wrong foot to say the least.

INSTITUTIONAL TYPES, which are produced by different combinations of museum purpose and organization, have correspondingly different kinds of buildings, so that planning for an institution presupposes knowledge of a special category of experience as well as general knowledge of museums and familiarity with the particular case. Some of the required special background can be found in books, and these should not be overlooked.

Public museums, a group that shows much diversity as to size and development and that embraces museums in the several fields, can be taken collectively as the principal type. To name something in print on all the different sides of public museum work would call for references to many publications of the American Association of Museums, especially the file of reportings and articles in *The Museum News* over the years, and also to publications of scores of museums. This comes close to saying that one should not build for a museum without having in camp someone who is thoroughly familiar with museum work.

A common feature of public museum organization that needs to be well understood, in the interest of planning with foresight, is the local society—whether it be an art association, or natural history society, or historical society. Society museums, as a class, are administratively *young* museums. The society type was the characteristic type of a century ago when all museums were young; and most of the local museums known today by society names are museums not yet fully grown up. Sooner or later a museum name is likely to be added, perhaps referring at first to a building only, but tending sooner or later to eclipse the society name. Thus we see the Boston Society of Natural History, Boston Museum of Science; the Grand Rapids Art Association, Grand Rapids Art Gallery; and the many little historical societies that have been as slow in adopting museum titles as they have been slow in developing, but that gravitate toward the public museum pattern when they come to building. For all museums alike, the growing process tends to change the parent society into a supporting membership group as, step by step, fraternal meetings fall off, trustees take control, volunteers are succeeded by paid workers, public services develop, and perhaps city support is forthcoming. The society thus becomes an institution. To recognize this may be to see ahead of the moment and to allow for developments that might otherwise seem out of reach.

The art center is typically a progressive art museum seeking, by use of a name made popular during the days of federal art projects, to declare its rejection of the worst aspects of traditional museum work and its espousal of some of the best sides of what art museums do. An art center may put most of its efforts into special shows of contemporary art, although this preoccupation would be natural for any progressive art museum. It may have more than ordinary activity in dramatics and dance, perhaps a little more in music, possibly more in creative art instruction, which however are activities of a great many art museums. Unless an "art center" is in fact just an art school going under this name, the center has a good auditorium and perhaps classrooms, just like a typical art museum. If the center has a building, this naturally is in modern style; the Walker Art Center at Minneapolis has made over the old Walker Art Galleries from Spanish Renaissance to modern. If the center has the beginning of a collection, perhaps from purchase prizes or gifts, it probably has an extension of its galleries projected. In short, the art center normally embarks on a strict museum career. And some centers have been frankly museums from the start; the Delaware Art Center at Wilmington, for example, is a first-rate little museum with its galleries on the main floor and its studios below; the Colorado Springs Fine Arts Center and the Des Moines Art Center are what any new art museum might wish to be, the latter created with funds bequeathed specifically for a museum. In short, to put up an art center building without providing, either at once or by planned extension, for all sides of museum work would be highly unrealistic.

DELAWARE ART CENTER. VICTORINE AND SAMUEL HOMSEY, G. MORRIS WHITESIDE II, ARCHITECTS

ROCHESTER MUSEUM OF ARTS AND SCIENCES, ROCHESTER, N. Y.
KAELBER AND WAASDORP, AND JOHN WENRICK, ARCHITECTS

Children's museums form a special-requirement group both on account of the small stature of their "public," and because subject matter should be conceived of and presented differently for children than for their parents. A voluminous ephemeral literature on this subject can be brought together by correspondence with children's museums and with the many public museums emphasizing kindred work. Also there is a book by Eleanor M. Moore, *Youth in Museums*, Philadelphia, University of Pennsylvania Press, 1941; and a more general book by Grace Fisher Ramsey, *Educational Work in Museums of the United States*, New York, H. W. Wilson Company, 1938.

PALO ALTO JUNIOR MUSEUM. DOLE FORD THOMSON, ARCHITECT

University museums are a distinct group administratively and with respect to their principal work. They sometimes hurt themselves by uncritically following the example of public museums, helpful as that example may be to them in certain ways. For a discussion of this sector of experience one may turn to the present author's *College and University Museums*, published by the American Association of Museums in 1942.

State museums form an uneven group that includes about a score of strong institutions. In the past, state museums have not been very different from local public museums except as to their state control and support; but leaders are now well along with a larger program: not only serving as information centers on state history and state resources in the widest sense, but also functioning as service and holding agencies for growing chains of small museums in state parks and of state-owned historic house museums. Distinct from the state museums but comparable in some ways are the state historical societies, which concern themselves more with library and archival materials. There is a discussion of these state institutions, with lists of state museums and state historical societies, in *The Museum in America*, published by the AAM.

National museums at Washington, D. C., form a group seldom added to. There are only two national museum buildings dating within the period of our present interest: those of the National Gallery, 1941, and the Freer Gallery, 1923. The U. S. National Museum has a building of 1911, and also a building of 1881 that is dwarfed in interest by the older Smithsonian building.

UNIVERSITY OF COLORADO MUSEUM, BOULDER. CHARLES Z. KLAUDER, ARCHITECT

PROJECTED ILLINOIS STATE MUSEUM, SPRINGFIELD, ILL.
C. HERRICK HAMMOND, SUPERVISING ARCHITECT

(LEFT) LAKE TRAILSIDE MUSEUM, YELLOWSTONE NATIONAL PARK. HERBERT F. MAIER, ARCHITECT

Trailside museums are mostly owned by states or the Nation and are in state or national scenic and historical parks. A very few trailside museums are branches of public museums, and are in urban or suburban parks as at Cleveland. These little museums, of a numerous and multiplying class, are typically devoted to telling the story of the immediate site. Their structures are often joined with park administrative quarters, or—better it seems—with information centers that are posts for rangers or guides. For a discussion

NATIONAL GALLERY OF ART, WASHINGTON, D. C. JOHN RUSSELL POPE, ARCHITECT
OTTO R. EGGERS AND DANIEL P. HIGGINS, ASSOCIATES

of trailside museums one may see the *Field Manual for Museums* by Ned J. Burns, Washington, D. C., Government Printing Office, 1941.

Other kinds of museums are not much concerned with building. A few historic house museums, to be sure, have put up annex structures to hold supplementary collections; and for this subject one may see the author's *Historic House Museums*, American Association of Museums, 1933. Library museums, which are sub-museums belonging to public libraries, have in a few cases been responsible for museum additions to library buildings. However, this arrangement is strongly discouraged by students of libraries as well as of museums.

Planetariums are specialized public museums, some of them connected with larger institutions and some of them independent. Aquariums and buildings of zoos, also museums in some ways, have unique physical requirements that are not directly considered in this discussion.

EXHIBITS AND RESERVES are the two main groupings of museum material for which housing plans are required. Neither category should be overlooked, no matter how little material there may be at the time of building.

Reserve collections, in the broadest sense, include much of what is on exhibition as well as what is not, since many exhibits are retired on occasion, whether piece by piece or in blocks. Thus a museum logically conceived would, from the first, require space for both compact live storage and extended live display. This plan would be helpful even to a new museum with not enough material to fill its display space, since attention would thus be called to the storage requirement, which is a sure need of the future likely otherwise to be minimized in planning.

Either exhibit space or storage space may become crowded. Pressure of this kind at any point should bring up the question of enlargement of storage space rather than of exhibition space. The common practice of filling existing rooms to overcrowding *with exhibits*, and making this the reason for adding to the building, is fundamentally unsound. In principle, exhibits are selective and should be adapted to given space, whereas reserves are comprehensive and may require added space from time to time. As the quantity of reserve material increases, its use should develop for reference and study and in time for research. The organization and arrangement of reserves may well anticipate such developments from the start.

Space for reserve collections, or study collections, usually called study-storage space, should be planned in workable relationship to other parts of the building (Chapter XV) and should be equipped for service according to the nature of the material it will contain (Chapter XIX). The space initially provided should be planned in a way to allow for adding more space without disrupting the scheme of things in the building. One of the most serious missteps in planning, and one that is commonly made in planning for a newly created museum, is to relegate the storage problem to the indefinite future without making any plan for its solution or, worse yet, with immediate plans that cut off every possibility of providing properly for reserve collections at a later time.

Study storage of collections is *live* storage. No part of any collection should be put in dead storage unless it is on its way to the discard with all possible dispatch. Science museums have long had live-storage space, in generous proportion but not in fully workable relationship to other spaces as a rule. History museums as a class have been very slow in making live-storage provisions, in consequence of which they have suffered severely from crowded exhibits and packed overflow. Art museums, though aware of the need for planning rather than makeshift in this respect, have commonly let themselves in for basement storerooms and other unsuitable storage spaces. A recent article well reviews conditions and needs: *Study Storage—Theory and Practice* by Clarence S. Stein, *The Museum News*, Dec. 15, 1944.

Exhibits should be envisaged as made up of objects chosen to carry out a plan within a given space. They should not become an uncurbed accumulation, pressing for more space after glutting what space there is. Objects on display, whether borrowed or acquired for the exhibits, or selected from the reserve, should in principle be on view for the duration of the plan to which they contribute. Thus many exhibits are temporary in spirit, although not every installation can be changed after a few weeks or a month or two like installations that are called temporary.

There are several kinds of avowedly temporary exhibits. Transient shows in art museums are likely to be of borrowed material, perhaps on circuit from museum to museum. Also, in museums of all kinds there may be installations of things of timely interest: selected recent accessions, the object of the week, material illustrating current news, even perishable works of nature.

Permanent exhibits consist as a rule of a museum's own possessions, perhaps with things the museum holds on loan. At best they include some objects too important ever to be retired from view, and they may include displays such as period rooms and large groups that are too unwieldy to be moved unless for final disposal. There is lively interest, especially among the smaller museums, in miniature dioramas for use instead of full-scale period and habitat groupings.

Space assignments to different exhibits should be made according to a plan which brings forward what is of most general interest, including temporary exhibits. No donor's plan that goes against the museum's interests should be allowed to shape the arrangements. For this reason material should not be accepted under conditions of gift or bequest that require its being kept together or always on display. Every museum requires freedom to arrange and rearrange its exhibits, and to retire any part of any exhibit at will.

Exhibits seem to be slowly taking on a pattern that sets apart what is of strongest appeal and most general interest to the public from what is primarily of use to special workers and students. Exhibits for the public are made with objects of outstanding importance and sometimes by installation of dramatic character; and they are arranged as a rule in sequence of time, or by place. Exhibits for special workers include things of less individuality; and they are organized in some appropriate analytical way. The aim for the public is inspirational and aesthetic; whereas for workers, the aim is didactic and utilitarian. Thus in art museums, the greatest art works are put forward for everyone. They are arranged by period culture, which provides for formal display, for composite installations of related objects, and for period rooms. Art exhibits for students and other workers are classed by substances and the techniques of the arts. In science museums, spectacular things including habitat groups are featured, and the arrangement is ordinarily either by geography or geological time. Science study exhibits are made up of specimens arranged to show classification, or morphology, or some major principle. In history museums, story-telling exhibits including biographical and episodic material and dioramas are put forward. History study exhibits, insofar as they exist, take in series of objects arranged by formal categories—perhaps costumes of one period, or prints of a certain vintage, or dishes, or silver, or some other selection for close scrutiny.

The two kinds of exhibits, for the public and for workers, have different physical requirements, as we shall see. And, by the way, the requirements of study exhibits are not to be confused with those of reserve, or study, *collections* which are files of material.

ADMINISTRATION, under the president and the governing board with its committees, is the job of the director. The director presides, first, over curatorial and library functions, these being carried out in a museum of size by staff members who, with their subordinates and technicians, may number up to scores. The director also sees to the performance of certain well defined, primarily educational, public services that should have separate staffs, perhaps sizable staffs, to make them effective. In addition, he exercises several kinds of operating functions that may have their own heads for financial business, membership, public relations, publication, and registration, besides the sphere of the superintendent. Operating staff members, together with their helpers (not forgetting the mechanical force, the watch, and labor) sometimes number several hundred. Whatever the scale of the work, certain distinct provisions are called for in every building and must be provided by planners. Other chapters discuss the different categories of space—for curatorial work (XV), for educational and recreational work and the library (XII–XIV), for business offices (XVI) and for building operation and the physically associated work of registration (XVII).

The director's office, with its business appendages, should be oriented to the main public entrance; and the connection should be close enough so that business callers do not have to explore among the exhibits in order to reach their destination—especially before and after hours of public attendance. The office in a very small museum, such as would have no guards, must be placed so that the lone director-curator can take charge of the public's comings and goings.

CURATORIAL DEPARTMENTS, or staff divisions headed by curators in the larger museums, may not be found in smaller museums except as divisions of the exhibits.

Among *science museums*, departments correspond to main divisions of natural science. There are curatorships of geology and paleontology, botany and zoology (or the two together as biology), and anthropology; and in some very large museums the field of zoology is itself divided into separate departments for mammals, birds, amphibians and reptiles, fishes, insects, and marine invertebrates.

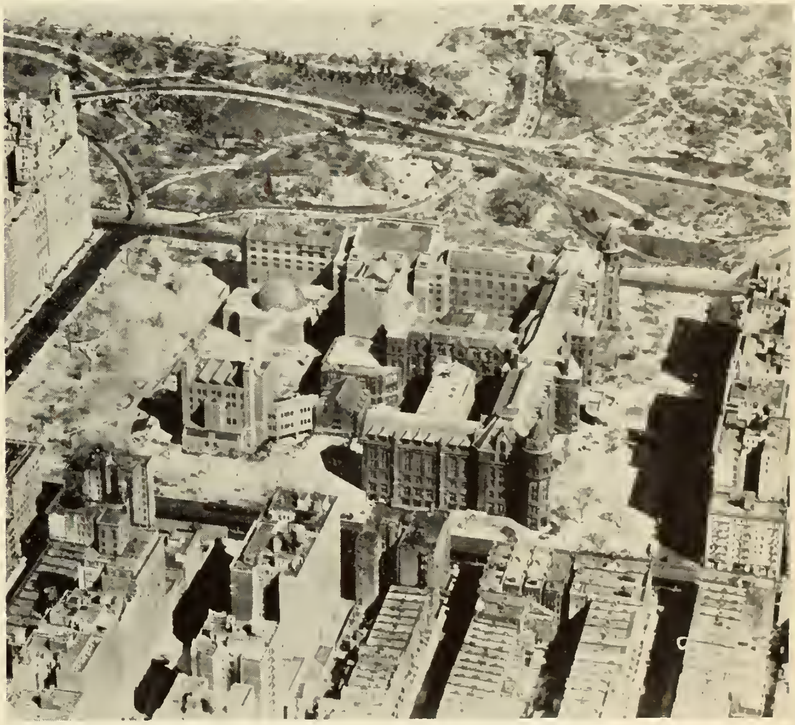
Planetariums have begotten some astronomy departments, and there are several departments of physics and chemistry. Exceptionally there are departments representing not classes of material but special lines of work, such as the American Museum's Department of Animal Behavior.

If an exhibit cuts across departmental lines, as one on flight or coloration in nature might well do, the exhibit is supposedly produced through collaboration between the departments concerned. But in fact it is usually the result of an effort by the director or the educational head, aided by the preparation department, to turn out something of more than usual interest. Such a feature exhibit would tend to be placed nearer to the main entrance of the museum than exhibits of strictly departmental character. This circumstance and the presence of occasional temporary displays tend to differentiate space near the lobby for general and changing purposes.

Among *art museums* there is commonly not much in the way of departmental set-up, although large museums have curatorships for Egypt, the Orient (or the Far East and Near East divided), ancient Greece and Rome, and Europe of the Middle Ages. There is at least one department for Renaissance and Modern Times in the West; but as a rule the West from the Renaissance is represented by a curatorship of paintings, and sometimes also by curatorships of prints and drawings, textiles (taking in all textiles), and decorative and industrial arts. Early American decorative arts and architecture have a department at the Metropolitan Museum (American Art), but exhibits without corresponding separate curatorships typically represent this subject in art museums. Contemporary art, and especially contemporary American art, is represented more commonly by the entire efforts of small museums, and of several well known special museums, than by formal departments. Many a new museum with no specialized curatorships at all is in effect a museum that has a small department of paintings, concerned mostly with American paintings, and that may have also the rudiments of a prints department.

Special exhibitions in art museums may follow whatever departmental lines there are. They attract the public because they are ephemeral, and frequently also because of their importance. Such exhibitions tend, once again, to differentiate a special kind of exhibition space in the best display position—near the lobby.

CURATORIAL STAFFS ARE LARGEST IN SOME OF THE LEADING MUSEUMS: UNITED STATES NATIONAL MUSEUM, WASHINGTON



AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK, N. Y., AND (BELOW) METROPOLITAN MUSEUM OF ART, NEW YORK

Among *history museums* as a class there is hardly any curatorial organization, although hints of department lines are seen—and should be strongly encouraged—in the arrangement of exhibits with chronological and topical divisions on the one hand and technical divisions (costume, furniture, arms, ships, etc.) on the other. Special topics and special groups of objects are sometimes put forward.

Industry museums are as yet too few for discussion in general terms, although their departments represent the sciences (principally physics and chemistry, with some biology), the natural resources (forests, fuels, metals), and the application of science through engineering, transportation, industry, agriculture, and human welfare.

The curatorial staff and its sub-staff, in a museum of any kind, may be large enough to make extensive office demands apart from space requirements for the museum materials concerned. However, in museums of intermediate size, that are neither well staffed nor yet without specialized personnel, curatorial work is usually carried on by one or more persons of broad background and perhaps also some volunteer associates who are well informed in certain special branches. There almost have to be helpers for the care and use of collections and related clerical work. If a little group of such workers can be viewed as a rudimentary typical staff, needing only to be developed along lines of general experience, physical planning is clarified.

PREPARATION, or the work of preparing material for the collections and the exhibits, is carried on by artists and craftsmen known as preparators in science museums and as repairers or restorers in art museums. In many a small museum the director does what he can of such work by himself and wholly unaided, but in a very large museum there may be dozens of people so occupied year in and year out. The shop and workroom requirements for preparing and restoring are varied. We shall come to this subject (page 197) in considering service quarters, although some workers on the collections are better provided for where the collections are kept in curatorial quarters.

PREPARATOR PAINTING A GROUP BACKGROUND

Courtesy Milwaukee Public Museum

RESTORERS EXAMINING AND RETOUCHING WORKS

Courtesy Walters Art Gallery, Baltimore

REGISTRATION and kindred functions, partly administrative and partly curatorial, are tasks of the registrar, associated in a large art museum with someone to manage traveling exhibitions. There may also be assistants as required. The quarters of the registration staff, whether of one person devoting part time to registration or of several full time workers, are best placed in the neighborhood of the service, or receiving, entrance (page 189). Here also the photographic workrooms are conveniently located (page 194).

THE LIBRARY is a department having the care of books and kindred materials, and often of photograph collections and lantern slides. It carries on services for the museum's staff and for the public, including outside work by correspondence.

The size of the library, relative to the institution as a whole, differs generally in the different fields—the library tending to be proportionately larger in history museums, where the library tail sometimes wags the museum dog. State historical societies, with documents and archives to care for, tend thus to become essentially libraries; and they might better accept this role, and give over curatorial functions to the state museum, than to put up a library building with exhibition space on the top floor and museum functions correspondingly neglected. Local history museum libraries may keep in bounds by passing on to the local public library any geographically irrelevant holdings, and perhaps the genealogical category and newspaper files. Art museum libraries, which tend to parallel the art reference department of the public library, should make a working arrangement that gives them at least the more technical matter needed for reference in the care of collections, and that may duplicate some of what is needed for the public. Science museum libraries need not ordinarily keep full files of technical journals, but they should have what is required for their own taxonomic work on the one hand and the public's nature-study work on the other. Great museums have become the holders of some of the greatest libraries in their fields, but most of the smaller museums have all they can do to meet actual requirements of the staff and visitors.

The library should have a public reading room, stacks that can be extended, and perhaps other space provisions (Chapter XII). Books most in use by one or another curator usually stay where they are needed; but most books in general demand, and that cannot be duplicated, have to be centrally shelved. Books are not lent to the public. However, the lantern slide collection is for lending, and if use is active the care of lantern slides usually passes from the library to the educational department. Whatever the distribution of duties, the library and near-library functions call for a competent staff.

THE LIBRARY IS A REFERENCE AND SERVICE ARM

Courtesy Boston Society of Natural History

MUSEUMS HAVE EDUCATIONAL PROGRAMS FOR CHILDREN AND ADULTS. INSTRUCTION AT METROPOLITAN MUSEUM

EDUCATIONAL WORK gives the modern museum much of its character, and serves also as the key to public support. A new museum building should recognize the needs of public instruction if city appropriations or membership revenues are wanted; and it should serve these needs well if the staff is to do a good job of public service. Actually, though, many buildings have their teaching facilities very much overrated. Museums often receive uncritical praise for the up-to-date character of their non-exhibition spaces, although the truth is that buildings tend to make better provisions for administration and physical running of the institution than they do for the educational group of functions including museum extension. However, there are many exceptions. Two museums have whole buildings for school service; some have special suites; one has an entire mezzanine floor; and not a few have scattered special rooms that collectively make good provision.

The nature of educational work is much discussed in serial and ephemeral museum literature, and we have already noted Ramsey's book on this subject (page 13). Suffice it to remark here that museum teaching, if sound, is teaching *from collections* — not wholly bookish, or wholly wordy, teaching. The unaided word, spoken or printed, is the tool of other methods. The museum relies upon the thing itself — interpreted by words. What this means on a building blueprint is that exhibition rooms are at times also partly classrooms and should not be too compact; that separate classrooms should be planned in some workable relation to exhibits and storages; and that lending service has to do with lending of things that take up a great deal of space on shelves. Four kinds of rooms are needed: a sizable room for assembly, classrooms and studios, a place and equipment for the lending collection, and space provisions for the staff itself. The educational staff, including those who manage, instruct, do extension work, and assist in any of this, may number from one to twenty or more.

The art school program of art museums, embracing instruction in painting and perhaps modeling and other arts and crafts, raises basic questions. Some maintain that professional preparation for the career of artist is no affair of museums, and that art school and museum ways of thinking and of acting are too far apart for reconciliation. However, studio work as "laboratory" experience, to give laymen some idea of the problems of artists, has become an established part of public educational work in art museums; and this pursuit leads almost inevitably to sustained studio work that may or may not produce artists. Further, in a small community there may be no other art school facilities, and the art museum may thus be under a peculiar responsibility. Actually, most art museums have full art school programs carried on in their buildings, although some of the large museums have schools associated with them under one board of trustees, but separately housed and perhaps separately directed. Where museum and school are separated in any way there is usually strong sentiment for closing the gap. The Toledo

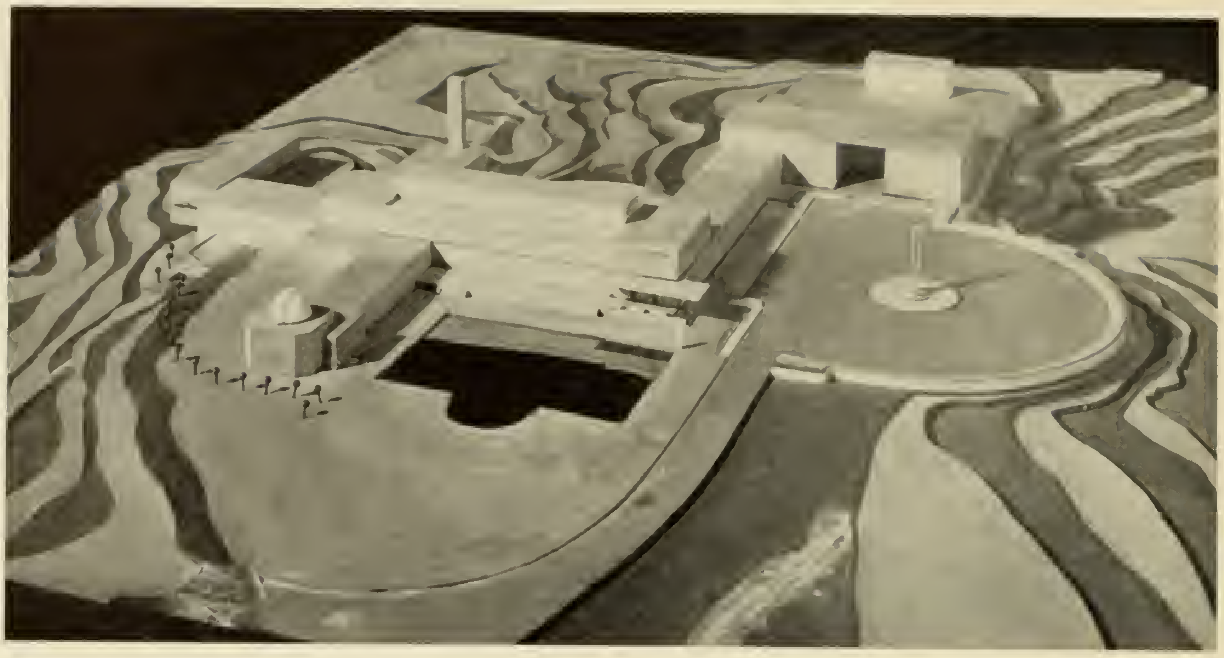
Museum of Art has given a demonstration of what seems the best arrangement; not long ago it consolidated its department of education with its school of design, both housed in the ample studio wing of its building. Fully a score of recent buildings provide for something like this on a smaller scale. The range of art work for which provision is made is steadily widening, and it tends to take in the industrial arts, especially emphasized at Chicago, in addition to the arts and crafts that have long had established places.

Courtesy Brooklyn Museum

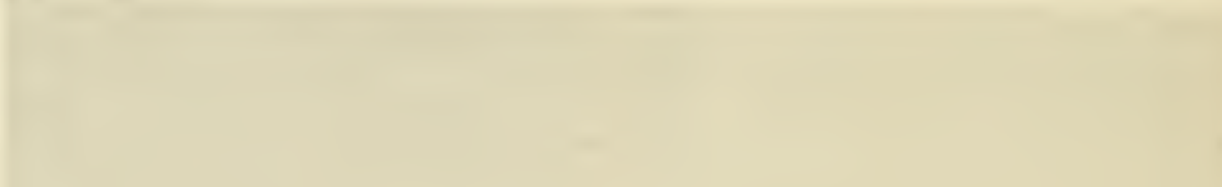
OPERATING TASKS ENGAGE THE SUPERINTENDENT'S FORCE

BUILDING OPERATION is the province of the superintendent, who is in charge of building maintenance also. The force responsible to the superintendent, including the mechanical personnel, the guards, and laborers, may make up the largest employee group of the institution. On the other hand, the superintendent may be the director's only helper in a small museum. In any case the same principles apply.

The superintendent's quarters, which are the seat of building operations, should be oriented to the service entrance. This entrance is typically in the rear of the building and at basement level. Through the service doorway pass many museum employees and the objects and supplies with which they are occupied. The functional relationships between this entrance and the spaces to which it relates, from power plant and shops, to storages and exhibition rooms, are matters of very practical moment. At least one museum has to stick lumber up the elevator shaft to get it into the building; some send each new accession to a far part of the building for the registrar to see before bringing it back to be photographed or otherwise disposed of. Some have no place to store crates when they unpack an exhibition; and there are reports of unpacking in the kitchen. Such goings-on are traceable to planning without much consideration of how the museum should work.



MODEL AND COMPLETED PARTS OF BUILDING, CRANBROOK INSTITUTE OF SCIENCE, BLOOMFIELD HILLS, MICHIGAN. ELIEL SAARINEN, ARCHITECT



CHAPTER III. PREPARING TO BUILD

The best approach to building is by not going off half-cocked. Many a lasting ill has come from spending a bequest or a public fund on some footless museum structure for which the occupant body has only just been formed, if in fact it yet exists. A museum needs to find itself before it can be well housed. Makeshift quarters of almost any kind that will not defeat themselves by being too good are the surest preliminary to a permanent home that will prove to be good enough.

THE TASK OF THE BOARD of trustees presiding over a building project starts with the developing of a program. There is a substantial body of museum experience that can be useful as background, but trustees have been known to pass over all such guidance and accept decisions from an architect who has also passed it over for all practical purposes. Where this is done no one should be surprised at a result that is far behind the times. In one such case the architect defined his entire problem as follows: "This building requires the satisfaction of its logical program; consisting of the orderly disposition of the galleries, their ready accessibility and ease of circulation, their varied shapes and sizes, their flexibility, their proper relation to the exhibits, as well as landscaped terraces and inner courts that may afford restful punctuation to the routine of the visit." A display museum, nothing more, was envisaged. This has happened again and again.

The trustees of a new museum should, if possible, get a good director as the first move toward creating an organization. The project can then be developed realistically with the help of the person who in some ways has most at stake. Several recent buildings—the Des Moines Art Center among them—have thus grown out of deliberate preparation by the nucleus of a staff. If this method cannot be followed a museum consultant should be retained; and for such service the director or superintendent of some museum with a good new building may be available. The Denver Art Museum, after a long history in temporary quarters, recently made the sensible move of employing a consultant for several months, to make a study of the institution and its community setting, by way of preparation for planning a building. In any case, the committee has the duty of getting together a statement of what spaces and other facilities are required, and of how they should be related. Many a building reveals good intentions on the part of its planners but gives little indication that the planners ever found out what they wanted.

One of the products of preliminary work should be an itemized schedule of space requirements for the different divisions of the museum's work. Preparation of this inventory calls for basic decisions as to how soundly curatorial work will be provided for, and as to whether there will be proper recognition of educational, administrative, and service needs. In short, this is the point at which the institution's career is being predetermined.

As a very early step, the financial and legal situation should be explored. If land or a building fund, or both, are already available, or if any other arrangements have come already made, their terms should be studied and any dangers in them discovered. If a donor, an estate, or a public body has the initiative, and therefore some control, the time to identify any restrictions is before work gets under way. Then, better than at any later time, unwise terms may be modified through considerate and informed discussion, or through pressure in the public interest if need be. For projects starting from scratch, without funds or other practical history, the trustees should make their own terms—partly, by the way, through planning for income as well as a building fund. When the time for building comes, the trustees should thus know exactly what powers they have in the use of funds from whatever source, and in other matters of business, politics, and law.

Within these questions there is sometimes the problem of how to deal with memorial purposes. Many building projects owe their origin to a donor's wish to be remembered or to honor someone; and not a few have come from the commemorative aims of organized groups. Whatever the merits of any particular case may be, it can be said in general that memorial features tend to work hardships upon museums and that they may well be approached with caution. A memorial to a benefactor may be handicapped in finding future support because people think that all provisions have been made. A historical or patriotic memorial, on the other hand, may have to take on character not reconcilable with museum work. There was much discussion of war memorials in the press a few years ago, and the prevailing view was that broad memorial ends are best served not by utilitarian buildings such as museums but by structures of purely inspirational character devoid of practical use. Experience shows that if there must be a memorial created through a museum it is better to attach the memorial name to the building or some part of it than to embrace it in the corporate title.

The trustees usually carry out their task through a special building committee of the board. This committee, in step with its museum consultant who at best is employed as the director, has the duty of preparing a statement of requirements, and in due time it has the task of finding an architect, or architectural associates, and a consulting engineer. The architect makes preliminary sketches, and this first solution and all succeeding adjusted solutions are studied by the committee, the consultant, and the engineer. When all differences have been composed as well as they can be, within the framework of what the available or obtainable money will pay for, it is time for the architect to prepare final drawings and specifications, and to let contracts. The construction job then follows in regular course.

From start to finish there should be team work. One hears a great deal about the lack of cooperation through shortcomings of architects; but plainly the trouble is not all on one side. The building committee, which by the way should be quite as strong as the architect, has the duty of understanding the problem, just as the architect has. This should help to produce a meeting of minds.

LAND AND CAPITAL for public museum buildings come sometimes from the city, sometimes from an individual by gift or bequest, less often from a number of people by private subscription or public fund raising campaign. A combination of sources is not unusual; in many familiar cases the land has been set aside by the city, part of the building fund has come from a city appropriation of current revenue or capital, and the balance of the building fund has been raised by general subscription. Counties, with rare exceptions, have not done much for museums in this way, although counties in certain states contribute toward running expenses or give other aid. Neither the states nor the national government take much interest in local museum construction, except that during the 1930's there were federal grants and loans to cities for museum buildings as part of the emergency program of public works. However, cities are very active in getting museums housed as well as in later support of museum work.

Under a plan, now common, by which the city provides land and building for use by an incorporated museum, many park sites have been made available. Park land, whatever its charm and safety, may have the disadvantage of being remote from the city center. For this reason there is a growing practice of having the city acquire an in-town site especially chosen for museum purposes.

If land is provided by the city and, as often happens, the building is to be erected by the museum from its own resources, the problem of tenure is presented. There is a parallel question in the commercial field when a building is erected on leased land. The usual protection for the lessee, in such a case, is a lease for a longer period than the productive life of the building, perhaps for ninety-nine years. Long tenure of public land might be difficult for a city to grant, but in practice a renewable grant for a shorter period ordinarily proves to be a permanent grant. Another possible form of protection for the museum would be that of penalties upon the city in the event of dispossession. Under this plan the city, in consideration of the readiness of the museum to erect a building, would allocate land for an indefinite period and retain the right to terminate the grant and repossess the property under condition that it pay to the museum the depreciated value of the permanent improvements, provisions being made as to the method of appraising this value. Although such a grant would be temporary, in practice the power of repossession would probably not be exercised by the city.

If, as may happen in some states, there is doubt as to the legality of any such contract between city and museum, it should be possible to remove this question by amendment of the city charter through state legislation. The following amendment to the charter of Buffalo is in the interest of one museum:

"The Council of the City of Buffalo shall have discretionary authority to provide a site and furnish money for the construction and equipment, in all or in part, of a building for the use and occupancy of the Buffalo Society of Natural Sciences. Such a site may be provided either by setting apart for such purpose land owned or acquired by the city for park or playground purposes, or by purchasing or otherwise acquiring land or property not previously devoted to a public use. The Council may provide the money for such site or building or equipment by the issuance and sale of its bonds in such amounts, for such terms, and at such a rate of interest as it may determine, and such bonds shall be issued and sold in the manner provided by this Chapter."

It is felt, however, that *special* legislation, for the benefit of only one museum, need not be encouraged. The first requirement is the adoption in each state of a general enabling act, perhaps covering both the matter referred to here and that of continued support for museum operations from current city revenues. The latter subject is well treated in the following Ohio act (Ohio Laws 1925, Section 4020):

"The council of each city may appropriate from its general funds, or may levy and collect a tax, not to exceed one-quarter of one mill on each dollar of the taxable property of the municipality each year, and pay it to a private corporation or association, not for profit, maintaining and furnishing a free museum of art, science, or history, for the benefit of the inhabitants of the municipality, as and for compensation for the use and maintenance thereof. The city council may enter into a contract or agreement with such corporation or association setting forth the terms and conditions upon which the appropriations are to be made and paid."

As to methods of financing by cities, the following comments, which could well apply to museums, are made by Wheeler and Githens in *The American Public Library Building* (Chicago, American Library Association, 1941, pages 19-20):

"In the past, financing by the taxpayer has usually meant issuing bonds; today, in theory if not in practice, the trend is toward pay-as-you-go. Students of municipal government predict that the recent practice of voting heavy loans for municipal improvements and paying them off with accrued interest over a period of years will give place to the sounder method of levying an additional current tax over a period of years and placing the proceeds at interest, which will bring in, instead of paying out, money for the community. . . .

"Two kinds of municipal bonds are found in library building financing; sinking fund bonds and serial bonds. Sinking fund bonds bear annual interest and mature at one future date, presumably within the effective life of the public improvement. A portion of the annual tax revenue is set aside to repay the bonds at maturity. Serial bonds, on the other hand, are issued with differing maturity dates over a period of years, a fraction to be retired each year. Most municipalities have now adopted the serial method of financing public improvements.

"Pay-as-you-go plans mean either increasing the tax levy for one year to pay for a permanent improvement . . . or creating a fund to be set aside at interest by increasing the tax levy for a period of years. The second type is like a sinking fund in reverse and may be subject to the political manipulation and other evils of sinking funds."

Land given or bequeathed by an individual may or may not be suitable as a museum site. This question can be delicate and difficult to adjust; but public institutions have the duty of facing such problems objectively, and also without procrastination. Through a tactful effort the prospective donor may perhaps be induced to do a right thing instead of a wrong one. Or, after the fact, an unsuitable piece of land may perhaps be sold or exchanged for a better piece.

If the size of a gift or bequest has not been determined through careful study of what the community requires, freedom may be needed to seek additional resources. And this is not the only freedom that sometimes has to be sought. Building funds coming by gift or bequest have been known to bear terms and conditions ranging in their sweet iniquity from the tolerably bad to the utterly outrageous. What to do about the favors of patrons is sometimes a difficult problem; but one duty of trustees is not to hamstring their institution by yielding to what is wrong. To be sure, time remedies many things; but time does not always do this fast enough to vindicate trustees who have fallen down in their duty.

There have been instances of parallel bequests setting up what promised to be competing institutions; the record shows some very astute solutions of this difficulty. The Cleveland Museum of Art gives a well known example, coming as it did from a cooperative agreement between two trusts, each created without knowledge of the other; the result, after negotiations, was one building which the law sees in two parts. Kansas City offers another such case involving several sources.

Competent legal advice is essential at the time of preparing to build. If the secretary or some other member of the board cannot give this help, then outside counsel should be retained.

THE RIGHT ARCHITECT makes the building; the wrong architect breaks it. When trustees come to picking their man they should not plunge thoughtlessly or be guided by any consideration other than the best interest of the project.

There is sometimes a difference of opinion among members of the board as to whether the architect should be decided upon by *competition or direct choice*. Most people hold that an architect should be chosen in the same way as an engineer or any other specialist—on his record. It has been said of competitions in general that the architect who enters is thinking first of all not of the institution and the community but of how to get the job. "Thus he is always tempted to promise much more than he can give with the money to be spent." The American Institute of Architects does not in general favor competitions on the ground that they may be unfair to both parties and are often unproductive of the desired results; but, to minimize these difficulties, it has also drawn up a set of rules of competition procedure for the guidance of its members (*Architectural Competitions*. AIA Document No. 213). Copies of this can be obtained by addressing the Institute at Octagon House, Washington 6, D. C. Wildcat competitions, open to all without formalities, are taboo. Legitimate competitions may be open, or limited to firms invited to submit sketches for which each should get a stipulated fee, or open at first and then limited to a few in later stages. But no matter how conducted, a competition is fundamentally at fault in calling for a solution before the problem can be properly studied. Competition preliminaries, no matter how scrupulously carried out under an official adviser, cannot take the place of protracted team work between architect, building committee, director, and technical consultants. Drawings prepared too soon are sure to be handicaps.

However, a competition may offer the only way to escape what would be an unfortunate appointment, as in the case of some government project, whether under federal, state, or municipal auspices, that might otherwise go wrong by political influence or bureau routine. Government architecture is proverbially backward, and if a competition can overcome its weaknesses in any measure then a competition is clearly indicated.

Be this as it may, there is ordinarily more to be said for the common sense method of just asking in a good man. This promotes the development of a program and the give-and-take which is so important as the work goes along. If, as sometimes happens, a good local architect or someone else who qualifies in most ways is lacking in museum experience, an associate architect with the proper background may be appointed. Not the least of architectural qualifications at present, in view of the recent style change among museums, is ability to design in the modern way.

Another very important matter is that of engineering consultation. The electrical engineer and the heating and ventilating engineer are not infrequently summoned only after others have made needless mistakes that cannot be remedied. For best results there should be meeting of minds at every stage.

Business methods in dealings with architects and consultants are matters of regular practice, covered by printed standard forms of agreement and explained in leaflets of the American Institute of Architects (*Principles of Professional Practice*, AIA Document No. 225, 1945; and *Professional Practice of Architects*, AIA Documents 117, 1942; both gratis) which the building committee should send for if it is not already familiar with the subject. The architect's fee depends upon the kind of building, size of building, and other governing conditions. For many years the established minimum fee was 6 percent of the total cost of the work, with rates up to perhaps 12 percent for projects requiring prolonged study or involving high production cost to the architect, and also for small structures. However, many architects are now working on an entirely different basis—charging actual drafting and office costs either multiplied by a factor or with an added fixed fee to cover the architect's individual part. The services rendered "consist of the necessary conferences, the preparation of preliminary studies, working drawings, specifications, large scale and full size detail drawings; the structural and mechanical design for the contract drawings and specifications; the drafting of forms of proposals; the taking of bids and the preparing of contracts; the checking of shop drawings; the inspection of models; the issuance of certificates of payment; the keeping of accounts; the general administration of the business and supervision of the work." This is no small task. The drawings alone may number several dozen large sheets of plans, elevations, sections, and details, and there may be several hundred pages of technical specifications.

WORKING OUT THE PROJECT calls for a series of team plays between the building committee, director, architect, and engineer. But all too often it evokes a struggle. There have been cases of difference in which a solution was sought by letting each party take one aspect of the problem, the committee perhaps making off with the inside of the building and the architect with the outside. Such a procedure goes against first principles, giving what is literally a house divided. Good designing is of course a process rooted in planning, and good planning cannot cast off considerations of the developing design.

There has been some misunderstanding about the alleged sin of not designing buildings "from the inside outward," by which is usually meant that the façade is drawn first and the floor plans afterward. Wheeler and Githens (page 55) say to this point that "The floor plans are invariably studied first, and the exterior designed to fit the floor plan and 'express the plan,' as the architects' vernacular has it. For a hundred years or more the Ecole des Beaux Arts has taught this sequence, all the American schools teach it, and if the architect sacrifices plan arrangements to the exterior, he has gone astray and forgotten his training." But this does not really dispose of a serious difficulty, which is that limitations imposed strictly by style are commonly taken for granted before the planning begins, a familiar instance being the assumption of a symmetrical plan and a balanced front elevation. Nor does the architect's order of work always prevent "expression" of the plan by screening it, alas, with an irrelevant façade. The services of a competent and up-to-date architect will steer around these mistakes if the committee does not obstruct.

Ill-advised copying is one of the surest ways of going wrong. One can see among museums of the past that some of the worst mistakes have been copied again and again and so have become as familiar as many a good example. Effective arrangements deserve to be noted and used in appropriate adaptation; but determining what is good and how to use it calls for a great deal of understanding. Observation of others cannot yield safe guidance without adequate study of the problem in hand.

Analysis of the project should overcome much of the familiar difficulty over ideas appearing after construction is under way. The aim should be to plan, not to muddle through. Exercise of foresight is an excellent way to save money. Contractors' estimates vary inversely as the thoroughness of plans, and a bid 36 or 40 percent lower than others may hold in store a lot more of misunderstanding than of ultimate advantage. Building operations completed without extras are unusual, but extras that mount to much more than 5 to 10 percent are preventable.

Many points that might be overlooked are to be found, by the way, in the index of the present volume, which has been prepared to serve as a check list.

While plans are being studied it may be exceedingly helpful to have a simple architectural model for visualizing arrangements as proposed. If this model is made of blocks, each perhaps representing a functional unit, there is opportunity to rearrange and adjust. Some of the buildings that have been partly planned in this way show the value of the method in securing space economy and sound organic structure.

The architect is rightfully interested in many accessory things that assist or impair the final effect of the building; and an understanding about such points at the outset may save friction and should make for good results. All matters of finish are strictly of this kind. Equipment, if it be of special design, is another case in point. Standard equipment may be bought by the committee; but the architect should at least know what is planned (see page 235) and should advise if need be. Plantings around the building are still another concern of the architect since they will greatly affect the appearance of the building.

When all the sketch plans and preliminary drawings are finished, and the architect makes working drawings and proceeds to carry out the work, it is important that the building committee and the director continue to keep in touch with what is done.

After the building is open, the museum may well publish in some architectural journal a full description of it with plans, exterior and interior views, and a construction outline giving names of contractors and dealers. One of the best examples of this in print is the description of the Museum of Modern Art, New York, in *Architctural Forum* of August, 1939. A museum that has reprints of its description for inquiring building committees will save its staff no end of time and trouble for many a year, and the service to others will be important if the building itself is good.

(ABOVE) CHICAGO NATURAL HISTORY MUSEUM. COST (1921) $7,000,000 FOR POPULATION OF 2,750,000 AT THE TIME OF COMPLETION

(LEFT) SANTA BARBARA MUSEUM OF NATURAL HISTORY. COST (1922 1939) $160,000 FOR POPULATION AT TIME UNDER 35,000

CHAPTER IV. SIZE AND COST

Public museums seem to be molded by chance, lack of funds, rivalry, or a donor's guess more often than by actual needs. In fact, standards of size and cost have not yet been developed for museum building, and the best that planners can do is to study what others have done, and note a certain blind order of things.

SIZE of building is a measure of public institutions generally that tends to follow size of local population. Although in the case of museums there are many small buildings in large cities and some large buildings in small places, still there are rudiments of a pattern when it comes to relative size. This, in fact, is a matter of common observation, as is shown by the familiar inquiry about what "places of our size" are up to. The question is likely to be asked in terms of cost; but cost is a highly variable factor. It would seem better to ask how much *space* is provided as a rule, and then to take up the question of what that much space would cost.

The subject of building size is treated in a statistical study by Paul Marshall Rea, *The Museum and the Community* (Science Press, Lancaster, Pa., 1932) which finds that data for size suggest relationships to population that are now recognized as characteristic of public institutions with respect to various measurements of their development and activity. Taking exhibition floor area of existing museums as his index of size, Rea plots a curve from which it can be seen that size of building increases, but at a regularly diminishing rate, for each step upward in the population scale. Thus, if a place with 25,000 people had say one square foot per capita a place with a million people would be doing equally well with a quarter square foot per capita. Further, it can be seen from Rea's study that most of the records of building size, for what might be called good museums, are between the curve of the best records and that of 25 percent of the best. After considering carefully what to suggest here as a general guide, it seems realistic (both from Rea's data and from data for recent years) to take the zone between 25 and 50 percent of the best, remembering that the upper figures obtained in this way can be doubled without going beyond actual cases. Also, applying this conclusion, it seems right to assume that exhibition floor area is about half of the total floor area of the building, as we shall see in the next section. On the basis of these assumptions, and using Rea's method (*ibid*, page 218, equation 8, corresponding to the graph on Rea's page 90), the suggestions of Table I, below, are forthcoming.

TABLE I. SUGGESTIONS AS TO SIZE

Population	Total Floor Space
10,000	7,000– 14,000 sq. ft.
25,000	12,000– 24,000 " "
50,000	19,000– 38,000 " "
100,000	29,000– 59,000 " "
250,000	52,000–105,000 " "
500,000	82,000–163,000 " "
1,000,000	127,000–254,000 " "

It should be kept in mind that these data are given not as ideal, but as reasonable on the basis of actual conditions. Table I does not take account of the fact that in places large and small there are useful museums with buildings of lesser size than is here suggested. Further these data do not reflect differences between conditions in the several museum fields—history, as is well known, having many more little buildings than other fields, and art having more large buildings.

There has been considerable discussion among museum people as to how big museums should be allowed to get for their own and the public's good. This is distinctly academic since great cities will go on building vast piles, regardless for the present of talk about branch museums and decentralization. However, it is worth noting that in projects for the remodeling of New York's two largest museums there are schemes for division into units with separate entrances and other independent features.

A discussion of more immediate usefulness has to do with a bottom limit of size—the normal size of a museum in the smallest community that can support a museum. At present the number of very small places with museum buildings is relatively small, in spite of some good examples including the Mystic Art Gallery at Mystic, Connecticut (population 2,000 in 1940), the Door County Historical Society at Sturgeon Bay, Wisconsin (5,000), and the Highlands Museum at Highlands, North Carolina (500). Most small town museums occupy rooms or converted residences. Special circumstances are the deciding factors in so many cases that one cannot generalize, but in each of the cases mentioned above the total floor area is between 4,000 and 5,000 square feet. This represents less than two square feet per capita for Mystic and Sturgeon Bay, with populations under 5,000, and about ten square feet per capita for the little town of Highlands with a population of about 500. Unmistakably museums are moving into smaller and smaller places with smaller and smaller buildings.

How to reckon with a community's growing needs, in a museum large or small, is part of the problem of size. Library planners estimate population 20 years in the future and try to build for the anticipated demand; but museum planners seem to be forced as a rule to build less than they think is enough for the present time, although sometimes they compensate on paper by projecting ambitious enlargements. However, plans for the future are all too often negated in advance by designing in such a way that units put up first could never grow into functional larger buildings. Familiar indeed is the sort of beginning that provides fairly liberal exhibition space, and perhaps enough office and service space, but no adequate curatorial space and no provision for adding what is needed in any relationship much better than would be afforded by a nearby separate building. This shortsightedness is all the more strange in the light of a myth that museums are "permanent" structures—an idea that persists in the face of evidence all about that museums become obsolete in a few years. All things considered, museum planners might do well to provide as much as they can of the structure needed at once, planning this with a view to extension of curatorial space primarily, and recognizing that perhaps 50 years of life for any part of the building will give that part time to outlive its best usefulness.

How to build what is needed at once with the sum of money at hand is a question of adjustment between the interrelated factors of size, character of structure, and cost (page 41). Sometimes a study of plans will reveal opportunities for space economy; but otherwise if funds are inadequate something has to be left out of the project or the quality of construction must be changed, or both.

While these size calculations are under way, the building committee should not forget the future task of running the museum. The budget outlook as well as the building fund should be kept in mind lest the institution find itself with more house than it can run.

TABLE II. FLOOR AREA DISTRIBUTION

Museum	Building[a] Dates	Total Square Feet	Distribution in Percentages						
			Exhibits	Lecture, Library	Offices	Stairs, Corridors	Storage	Shops, Plant	Misc.
Metropolitan Museum of Art, New York, N. Y.	1880–1924	658,900	46	4	5	20	12	9	4
National Gallery of Art, Washington, D. C.	1941	433,400	42	3	4	4	4	37	6
Philadelphia Museum of Art, Pa.	1928 (–1948)	391,600	57	7	4	6	7	18	1
Art Institute of Chicago (including school)	1893–1939	349,000	44	25[b]	3	6	6	12	4
Art Institute of Chicago (not including school)	1893–1939	285,000	54	9	4	7	6	15	5
Detroit Institute of Arts, Mich.	1927	191,000	34	24	3	6	7	12	14[c]
Nelson Gallery of Art, Kansas City, Mo.	1933	147,000	54	8	4	6	8	12	8
Museum of Modern Art, New York, N. Y.	1939	112,800	32	20	13	4	6	19	6
Joslyn Memorial Art Museum, Omaha, Nebr.	1931	102,200	44	19	3	4	14	15	1
Cleveland Museum of Art, Ohio	1916	90,000	44	16	8	2	11	18	1
Fogg Museum of Art, Harvard University	1927	89,200	32	17[b]	10	12	19	5[d]	5
Freer Gallery of Art, Washington, D. C.	1923	70,000	57	7	5	6	9	12	4
Portland Museum of Art, Ore.	1932–1939	53,600	46	22[b]	2	9	16	4	1
Seattle Art Museum, Wash.	1932	53,100	33	13	4	5	14	25	6
Colorado Springs Fine Arts Center, Colo.	1936	49,100	21	40[b]	4	9	11	13	2
Columbus Gallery of Fine Arts, Ohio	1931	45,200	35	14	16	19	8	5	3
Fine Arts Building, State University of Iowa	1936	37,000	35	52[b]	3	1	4	4[d]	1
Norton Gallery of Art, West Palm Beach, Fla.	1941	31,300	38	10[d]	4	16[e]	6	11	15[e]
Speed Art Museum, Louisville, Ky.	1927	22,000	53	4	2	10	5	25	1

[a] Dates in () indicate periods of rearrangement after completion of building.

[b] Including university or art school classrooms.

[c] Including public spaces not used for exhibits.

[d] District steam service used. [e] Including parts of patio.

(Over)

TABLE II—*Concluded*

Museum	Building[a] Dates	Total Square Feet	Distribution in Percentages						
			Exhibits	Lecture, Library	Offices	Stairs, Corridors	Storage	Shops, Plant	Misc.
Mills College Art Gallery, Oakland, Calif.	1925–1931	20,300	40	26[b]	7	16	8	2[d]	1
Delaware Art Center, Wilmington, Del.	1938	16,100	28	26[b]	7	14	9	15	1
Blanden Memorial, Fort Dodge, Iowa	1932	4,500	61	16	2	3	6	3	9
American Museum of Natural History, New York, N.Y.	1877–1936	1,015,100	40	6	10	5	25	13	1
Chicago Natural History Museum, Ill.	1921 (-1949)	753,100	71	3	2	2	12	4	6
U. S. National Museum, Washington, D. C.	1911	468,200	48	3	16	3	22	7	1
Buffalo Museum of Science, N. Y.	1929	86,100	49	14	6	2	8	19	2
Ohio State Museum, Columbus, Ohio	1912–1929	76,300	35	14	16	19	8	5	3
Oriental Institute, University of Chicago	1931	69,300	25	13	20[b]	10	14	10	8
Newark Museum, N. J.	1926 (-1949)	56,600	66	4	8	5	10	4	3
Museum of the City of New York, N. Y.	1930	49,300	60	8	6	1	13	10	2
Cranbrook Institute of Science, Bloomfield Hills, Mich.	1938	43,900	41	16	7	10	7	17	2
Mariners' Museum, Newport News, Va.	1933–1941	40,100	62	8	4	1	5	6	14[e]
State Exhibit Building, Shreveport, La.	1939	30,100	52	15	1	2	10	12	8
Arizona State Museum, Tucson, Ariz.	1936	25,900	51	12	8	8	4	9	8
Big Bend Historical Memorial, Alpine, Tex.	1937	18,000	71	8	13	1	3	3	1
Laboratory of Anthropology, Santa Fe, N. Mex.	1931	17,400	31	21	9	10	11	16	2
Historical Society of Berks County, Reading, Pa.	1929	11,700	49	23	4	14	2	7	1
York Institute, Saco, Me.	1927	4,600	46	11	7	4	21	10	1

DISTRIBUTION OF SPACE between the principal museum functions is an important consideration at every stage of planning. A list of desired floor areas for different uses is an early requirement of the architect, and this list is useful to the committee whenever it has to struggle with adjustments.

A familiar rule of thumb is that in a new building there should be *at least* as much space for curatorial, administrative, and service purposes as there is for exhibition. As museums grow and add to their buildings there should come better provisions for curatorial work including storage, and therefore there is a tendency to allow more space in the first place for non-exhibition functions. Some people would give as ideal an approximately equal division three ways, between exhibition, curatorial work, and administration including services—a scheme that would prove itself sound in any growing museum, but that would give most new museums more storage space than they would need right away.

Neglect of the need for storage space, planned to be adequate and to continue to be adequate as collections grow and the building is enlarged, is one of the commonest mistakes of museum planners. Storage space is thus often relegated to the basement or the attic, where it cannot function or grow. This arrangement cripples the institution once and for all.

Perhaps the best rough working rule would be to allow half the total original space for non-exhibition functions, making very sure that this half includes the rudiments of a curatorial allowance so placed that it can grow in a natural way, and to increase the space for storage from time to time through additions to the building. This last essential result cannot be achieved by vaguely discussing expansion and then stepping aside while the wrong beginning sets a policy of indefinite expansion *for exhibits only*, and of neglect of space needs for growing collections that ought to be kept in expansible live storages from the start. Despite usual acknowledgment of the right principle by planners, the wrong course has been taken again and again; and the blunder has never failed to be lamented.

The data of Table II, on space distribution, are not given to be followed closely since most museums have inadequate provision for curatorial work and storage; but at least the table shows that exhibition takes up less than half of total space, both in recent buildings and in old buildings that have been somewhat corrected by enlargement.

COST AND PER CAPITA COST are matters that come up when the size of the building is considered. However, cost data of even a few years ago are no longer directly useful; whereas the data on size of building, considered above, are happily independent of change in prices.

Total cost, for present purposes, is taken to be the cost of only the building itself. This includes construction, fixed equipment, architect's and engineer's fees, and incidentals. It does not include the cost of land or of any extensive landscaping; land cost may be an erratic item, sometimes very large on account of choice location or of unneeded acres, sometimes wholly absent as in the case of a gift or bequest or a city grant of land. Cost might take in all movable equipment if the total of this category of expenditure could be known; but lumping this would be difficult since purchase of equipment may be spread over years and met from current funds. Therefore museum people usually count as part of the building cost whatever is paid for exhibition cases and other furniture required to open the building. Expenditure for exterior sculpture, which is sometimes a part of the building, is not reckoned as part of the building cost, if only because it may not be promptly incurred.

The costs of recent public museum buildings run from less than $20,000 to more than $16,000,000. The future may not produce another building to compare in cost with the $13,850,000 Philadelphia Museum of Art or the $16,057,000 National Gallery, and it will have a hard time catching up with New York's $15,000,000 record accumulation of structures put up since 1877 for the American Museum of Natural History. But there will be new buildings in all the lower brackets because there are voids at these levels to fill; and there will be many little buildings appearing as museums make their way downward in the population scale.

Per capita cost used to be discussed in terms as simple as they were misleading—flatly so much per capita, regardless of the size of community. Museum people have never agreed on a rate; librarians used to say $2 a head. But any *fixed* rate would be wrong because, as we now know, data for cost—like data for size of building—tend to follow a curve that drops rapidly for gains in small populations and levels off at a comparatively low rate for large populations. This general principle holds and should be taken into account, no matter what rates are thought sound under present museum conditions.

A convenient way to get some idea of what should be spent on a museum in a place of given size would be to take the suggestions of Table I, as to number of square feet required, and multiply by *recent* cost per square foot. *Square* foot cost, by the way, should not be confused with the architect's *cubic* foot cost, employed in making more accurate estimates and adjustments (page 39).

Square foot costs vary widely, from less than $5 to more than $35 for museums. This range is the mixed result of differences in time, place, and character of buildings. However, a rate of $15 seems fairly to represent a dozen up-to-date buildings of various sizes; and, taking this figure—$15 a square foot—for present purposes, the results of Table III are arrived at easily. These suggestions for total cost may be replaced by other data, also figured from Table I, when the building committee knows its own square foot rate from discussions of work in view.

TABLE III. SUGGESTIONS AS TO COST

Population	Cost[a]		Cost per Capita[a]	
10,000	$105,000–	$210,000	$10.50–	$21.00
25,000	180,000–	360,000	7.00–	14.00
50,000	285,000–	570,000	5.50–	11.00
100,000	440,000–	880,000	4.50–	8.50
250,000	785,000–	1,570,000	3.00–	6.50
500,000	1,225,000–	2,450,000	2.50–	5.00
1,000,000	1,905,000–	3,810,000	2.00–	4.00

[a] Read carefully the accompanying text and also the text explaining the related Table I.

Tables I and III are products of rather rough and ready treatment, on our part, of full and exact statistical information. However, it has seemed better to make carefully considered suggestions than to give averages. Many buildings represented in the working data are plainly inadequate, and some have been shaped by exceptional gifts or other special circumstances in their favor. It may be of interest to see how closely the present suggestions come to figures proposed as library standards by Wheeler and Githens, which are as follows: Population under 10,000, cost per capita $12; 10,000 to 35,000, $7; 35,000 to 100,000, $5; 100,000 to 200,000 $4; over 200,000, $3.

CUBIC FOOT COST is the architect's cost rate employed to determine how much money is needed for a given design or what must be done to the scheme to meet building fund limitations. It is obtained by dividing building cost by standard cubic contents—the latter (often called cubage) defined by the AIA as "the actual cubic space enclosed within the outer surfaces of the outside or enclosing walls and contained between the outer surfaces of the roof and six inches below the finished surfaces of the lowest floors" (in each portion). For any particular building the *exact* cubic foot cost is obtainable only when the building is finished; but the architect knows from general experience about what it should be, and he is always interested in what other similar buildings have shown.

The architect's usual procedure is to work out approximate cubage from rough sketches and to multiply by a cubic foot cost that

TABLE IV. CUBIC FOOT COST

Museum	Building Dates	Cost	Cubage (*Cubic Feet*)	Cost Per Cu. Ft.
National Gallery of Art, Washington, D. C.	1941	$16,057,000	14,781,500	$1.09
Philadelphia Museum of Art, Pa.	1938	13,850,000	10,010,070	1.38
Detroit Institute of Arts, Mich.	1927	4,000,000	5,661,690	.71
Nelson Gallery of Art, Kansas City, Mo.	1933	3,150,000	4,205,700	.75
Joslyn Memorial Art Museum, Omaha, Nebr.	1931	2,371,400	3,000,000	.79
Museum of Modern Art, New York, N. Y.	1939	1,350,500	1,360,000	.99
Fogg Museum of Art, Harvard University, Mass.	1927	1,230,300	1,290,520	.96
Des Moines Art Center, Iowa	1948	700,000	650,000	1.08[b]
Avery Memorial, Hartford, Conn.	1934	607,700	975,000	.62
Colorado Springs Fine Arts Center, Colo.	1936	516,900	1,220,000	.42
Columbus Gallery of Fine Arts, Ohio	1931	486,400	996,280	.49
Reading Public Museum and Art Gallery, Pa.	1924	479,700	886,360	.54
Cranbrook Academy of Art, Bloomfield Hills, Mich.	1942	476,600	726,300	.66
Dallas Museum of Fine Arts, Tex.	1936	424,000	850,000	.50
Portland Museum of Art, Ore.	1932–1939	361,600	1,022,560	.35
Springfield Museum of Fine Arts, Mass.	1933	300,000	663,000	.46
Museum of Fine Arts of Houston, Tex.	1924–1926	300,000	613,000	.49
Norton Gallery of Art, West Palm Beach, Fla.	1941	290,200	505,000	.58
Seattle Art Museum, Wash.	1932	250,000	726,190	.34
Delaware Art Center, Wilmington, Del.	1938	243,000	334,500	.73
Mills College Art Gallery, Oakland, Calif.	1925–1931	136,700	411,160	.33
Washington County Museum of Fine Arts, Hagerstown, Md.	1931	115,000	140,000	.82
Blanden Memorial, Fort Dodge, Iowa	1932	40,000	148,520	.27

[a] See Table V for cost items included.

[b] At post-war construction cost.

(Over)

TABLE IV—(*Concluded*)

Museum	Building Dates	Cost	Cubage (*Cubic Feet*)	Cost Per Cu. Ft.
Franklin Institute, Philadelphia, Pa.	1933	3,530,000	5,405,000	.65
Museum of the City of New York, N. Y.	1930	1,700,000	985,000	1.72
Oriental Institute, University of Chicago, Ill.	1931	703,000	1,189,760	.59
State Exhibit Building, Shreveport, La.	1939	536,500	695,000	.77
Nebraska State Museum, Lincoln, Nebr.	1927	356,000	1,285,300	.28
Grand Rapids Public Museum, Mich.	1940	289,200	585,460	.49
Mariners' Museum, Newport News, Va.	1939–1941	238,000	576,000	.41
Connecticut Valley Historical Society, Springfield, Mass.	1927	119,500	215,000	.56
Historical Society of Berks County, Reading, Pa.	1929	99,000	172,750	.57
Arizona State Museum, Tucson, Ariz.	1936	94,000	258,500	.36
Big Bend Historical Memorial, Alpine, Tex.	1937	63,000	320,270	.20
Heard Museum, Phoenix, Ariz.	1929	63,000	122,840	.52
Baker-Hunt Foundation Museum, Covington, Ky.	1930	32,500	43,160	.75
York Institute, Saco, Me.	1927	31,000	66,380	.47
Door County Historical Society, Sturgeon Bay, Wisc.	1939	23,000	70,050	.33

seems to be about right. This gives total cost more or less roughly, and paves the way for adjustments if these are necessary. Meanwhile, data of Table III, or substitute data figured from Table I at whatever *square* foot rate seems applicable, will help the building committee to measure its plans by what others have done in places of similar size.

The building committee should note that in reckoning cubic foot cost, architects customarily eliminate the following items: Cost of land, with grading and landscaping; cost of movable equipment; and also architect's and engineer's fees. The counting out of land, together with any extensive landscaping, corresponds with museum thinking; but museum people commonly include initial equipment, and they always include fees. This discrepancy in practice, which by the way is not peculiar to museums, has been known to cause misunderstanding when the building committee and the architect discuss cost in terms of cubic foot cost. If the architect's method is followed, then the items eliminated from calculations should also be deducted from the available building fund when the size of the building is being decided upon.

The cubic foot cost of a number of recent buildings, reckoned by the museum method of counting total cost, is shown in the last column of Table IV.

Many factors enter into such figures to produce wide variation. There is the character of the building—the type of plan, construction, materials employed, finish, and extent of mechanical installations. Also there are geographic influences, since materials vary in price in different parts of the country, and because ideas of what is appropriate for public buildings differ from section to section and from small communities to large. And, in addition, there have been large variations from year to year, due to changing costs of labor, materials, and transportation. Cost records of past years would have to be corrected for increase in prices to be useful now. According to *Engineering News-Record* (May 27, 1948) the building cost index went up from a pre-War I level, designated as 100, to about 200 in 1917, and it held this level with fluctuations between 150 and 270 until pre-War II years when it began a long climb that reached 300 in the middle 1940's and 450 in 1948. This means in dollars that cubic foot costs, which had been less than 50 cents when the Cleveland Museum of Art was built in 1916, stood close to $1.00 during the 'twenties and 'thirties when many of the museums of Table IV were built, and were on the way to $1.50 by the time of the National Gallery in 1941. Contractors, naturally unwilling to put fixed prices on work, adopted a cost-plus-fixed-fee basis of bidding which both introduced hazardous uncertainties for the planner and held up the letting of contracts where competitive bids were required under the law.

Added to these disturbances were further difficulties of getting materials and permits under government priorities. Museum construction ceased with the Cranbrook Academy of Art, opened in 1942, and was not yet much under way when the Des Moines Art Center was opened in 1948. The best one can do in future planning is to be guided by the future's prices, in the light of what one can learn from the records of earlier years.

ADJUSTMENTS of first plans are almost always necessary after the architect makes his estimate of cost based on cubage reckoning.

At this stage it is expedient for the building committee to look into all possible calls upon the building fund, not forgetting any financing costs and allowance for unexpected extras. A common source of large surprises is the site, which may have underground water or buried rock. Legal complications sometimes arise. There are always miscellaneous small items. The building fund should long before have been scrutinized for its full availability, as there have been cases of funds, supposedly available for building, that later proved to be earmarked in part for other things.

In determining how many immediate needs can be met with the money available, the committee usually has to make cuts in size or quality, or both. Size, character of structure, and cost go hand in hand, so that if two are known the third can be found. Reducing the number of cubic feet means either compressing something or letting something go. Careful discussion of the workings of the museum, as nearly as they can be forseen, may point to some adjustments. Elimination of monumental features can be a fruitful source of savings. Many museums of the past could have saved from 10% to 25% or more of initial cost (to say nothing of yearly losses for many a year through inefficiency) by cutting out features prompted only by a style.

Savings made by reducing quality of construction should not be carried to the point of making an unsound or less than creditable building, but less costly materials may perhaps be adopted without any serious loss and sometimes even to advantage.

After all possible trimming, it may still be found necessary to defer the construction of some major portion of the building. If this is done care should be taken to see that the plans give a functional organization of space from first to ultimate form.

When the work has been carried out, some of the adjustments that have been made may be found to have resulted in extra changes. The bills for these extras often produce pain, if not misunderstanding or even a law suit. An allowance of 5 or 10 percent is commonly made for unexpected items in addition to contracted cost; but taking a little time for adjustments, instead of rushing them through helps to reduce the need for this margin.

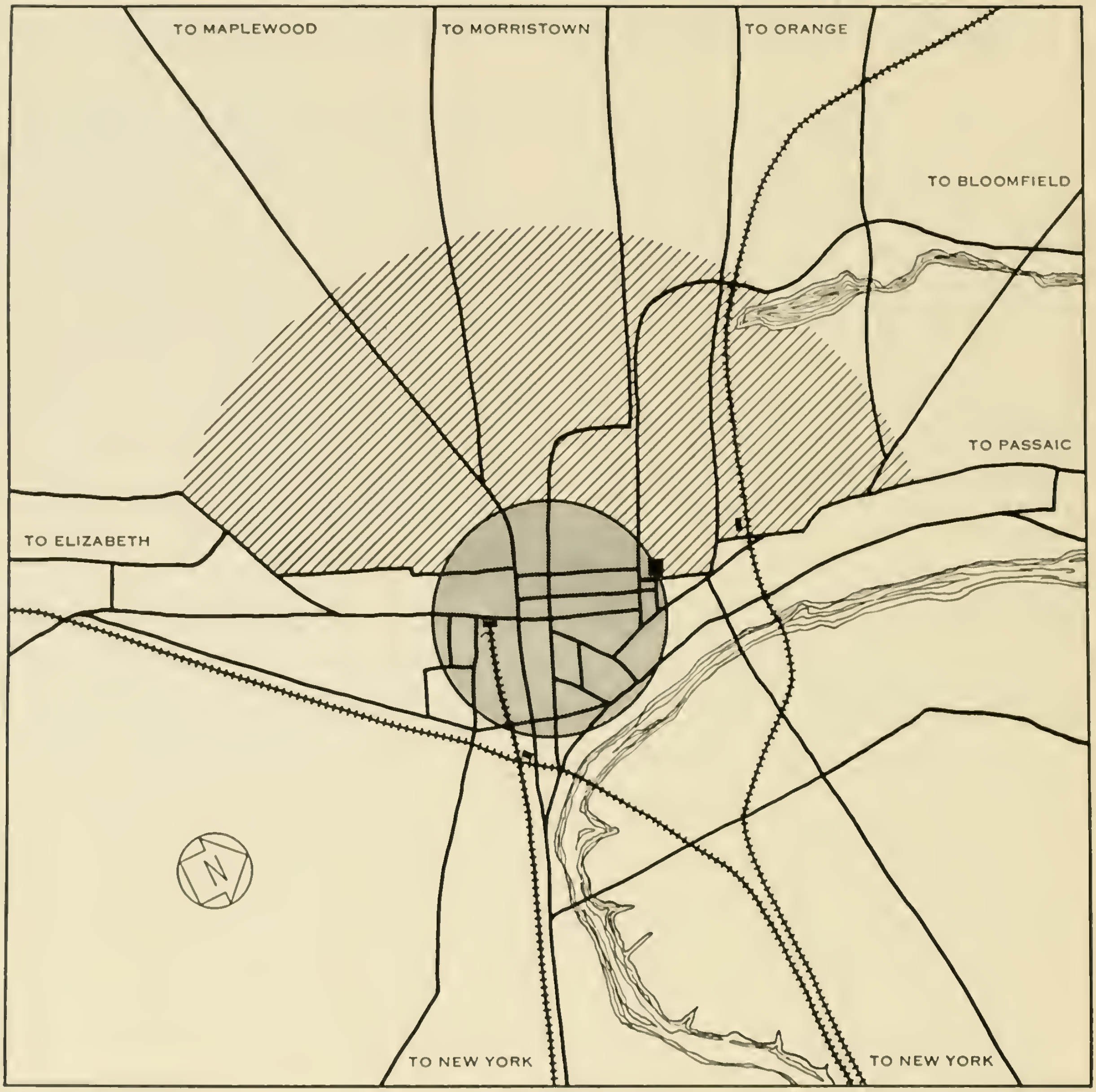
ITEMIZATION OF COST, or what the architect calls "cost breakdown," is helpful in checking preliminary estimates of cost. The following table gives itemizations for some museums of the 'thirties and 'forties. The relationships between items as given in percentages are relatively independent of changes that have come over prices; variations are largely due to differences between museums in their air conditioning plants, elevators, and other costly equipment.

Contracts are let in different ways according to what seems most expedient. The general contract sometimes includes plumbing, heating and ventilating, and electrical equipment; but some or all of these items may be grouped in a separate contract, or each item may have its own contract. As noted, there is no regular practice as to exhibition cases and furniture; the architect may let the contract for all movable equipment, or the museum may make these purchases after the building is finished, perhaps at intervals for years. It is desirable to have a separate contract for exhibition cases, and on the whole it seems best for the building committee to be responsible for this from the first, since the museum will have to buy more cases later on as a rule; but the architect should certainly be consulted. Initial commitments for exhibition cases usually depend for their amount more on the kind of museum than on anything else. An art museum may not require cases at first if paintings are its main concern, but a science or history museum is likely to need many cases at once. There are no cheap cases on the market, and making cases does not affect enough savings to pay for the bad result that is very likely to follow. For a poor museum the best plan seems to be that of getting a modest but sound start with a few good purchased cases.

TABLE V. ITEMIZATION OF COST

Museum	Total Cost	Itemization in Percentages					
		General Construc.	Plumbing	Heating, Conditioning	Elec. Work Elevators	Fees of Arch. & Eng.	Moveable Equipment
Nelson Gallery of Art, Kansas City, Mo.	$3,150,800	79	2	9	4	5	1
Joslyn Memorial Art Museum, Omaha, Nebr.	2,371,400	80	7	—[a]	3	6	4
Museum of Modern Art, New York, N. Y.	1,350,500	68	3	11	8	5	5
Avery Memorial, Hartford, Conn.	607,700	68	3	12	4	7	6
Columbus Gallery of Fine Arts, Ohio	486,400	76	11	—[a]	5	6	2
Portland Museum of Art, Ore.	361,600	69	7	8	7	7	2
Norton Gallery of Art, West Palm Beach, Fla.	290,200	72	3	5	8	8	4
Delaware Art Center, Wilmington, Del.	243,000	60	16	—[a]	14	6	4
Mills College Art Gallery, Oakland, Calif.	136,700	65	4	14	7	7	3
Blanden Memorial, Fort Dodge, Iowa	40,000	75	3	5	11	4	2
Franklin Institute, Philadelphia, Pa.	3,530,000	80	12	—[a]	—[a]	8	0
Oriental Institute, University of Chicago	703,000	70	—[a]	5	2	5	18
Rochester Museum of Arts and Sciences, N. Y.	558,600	68	3	8	8	11	2
State Exhibit Building, Shreveport, La.	536,500	78	2	8	5	6	1
Grand Rapids Public Museum, Mich.	289,200	73	1	11	2	4	9
Cranbrook Institute of Science, Bloomfield Hills, Mich.	238,100	68	16	—[a]	7	2	7
Mariners' Museum, Newport News, Va.	238,000	70	3	5	2	6	14
Connecticut Valley Historical Society, Springfield, Mass.	119,500	73	8	—[a]	2	5	12
Kingman Memorial Museum of Natural History, Battle Creek, Mich.	100,000	72	8	5	4	6	5
Door County Historical Society, Sturgeon Bay, Wisc.	23,000	65	5	16	3	6	5

[a] Included in item at left.



ROUTE MAP OF NEWARK, NEW JERSEY, SHOWING THE WELL-CHOSEN MUSEUM SITE OF THE NEWARK MUSEUM (BLACK SQUARE) NEAR CENTRAL BUSINESS AREA (SMALL CIRCLE) ON OR NEAR MAIN ROUTES FROM OUTLYING RESIDENTIAL AREAS, NORTH AND EAST, THROUGH CONGESTED SECTION (HATCHED SECTOR), AND NEAR RAILROADS

CHAPTER V. LOCATION AND SITE

PUBLIC MUSEUMS may be beneficiaries or victims of their whereabouts. The museum's location in the city plan, and the ground itself, should be chosen in the light of what the institution is and what it requires; but all too often an unsuitable location or site dictates its own terms, making the museum very much less than it should be.

ACCESSIBILITY to everyone, by easy means of conveyance if not on foot, would be ideal. But in a place of much size this result is likely, for more than one reason, to be out of reach. Several districts may make conflicting claims, and the problem may be complicated rather than clarified by the distribution of schools and of other institutions.

Unlike a library, which should put its main building at the business center and its branches in the principal neighborhoods, a museum has to decide upon one spot; and it must recognize in making its choice that a museum visit and a library visit are not alike. If museums had branches, there might be a closer parallel to the library situation, but as it is the museum's location problem cannot be solved by analogy.

Museum attendance is greatest on Sundays and holidays, and is made up largely of people who, if they are not tourists, are residents coming directly from their homes, often with family and friends, to spend an afternoon. There are also many participants in scheduled museum activities, including children and others coming in groups by appointment through the week. And there may be evening crowds for special attractions. This mixed clientele is almost uniformly intent on a prolonged museum visit. It is not made up, save very exceptionally, of people drawn from offices for a moment at noontime, or of shoppers with a moment between chores of the afternoon. There may be an opportunity in the idea of downtown branches with special programs for busy people, but experience of several museums in business centers suggests that quick lunch in the museum restaurant has the best chance of noontime attention. So it appears that for reasons of attendance, to say nothing of other factors, the best museum location is not at the busiest street intersection in the center of town but at a point of less flurry on one of the main arteries that great numbers of people follow habitually in going from their homes and that children can reach from their schools.

The counter claims of two different residential districts may be difficult to decide between, especially if both have dwellers of wealth and power. The poor are accustomed

NEWARK MUSEUM, N. J. JARVIS HUNT, ARCHITECT

to losing out; but they should not be too quickly dismissed. Several museums in "bad" neighborhoods have done remarkably well. This too seems to be a problem awaiting the appearance of branch museums in cities.

The location should be favorable to tourist patronage, since people from out of town make up a large part of every museum's attendance. This requirement has more bearing on nearness to highways and on parking facilities than it has on other kinds of accessibility.

Placing a museum near other public buildings or near a university may or may not be good for the museum. Grouping several museums—as around a plaza at Springfield, Massachusetts, or along the Mall at Washington—is helpful to all, provided the place is right. However, propinquity to the point of having several museums under one roof is disadvantageous, and so is the scheme of building a museum as a wing of a library or public archives, or as part of a community building, or convention hall, or courthouse.

PARKS are proverbially wrong places for museums. This is because so many museums of the past were put in outlying parks, where they were little used.

Now that the importance of accessibility and usefulness are fairly well recognized, there is a chance to ask whether *some* parks may not be all right. The conditions of a park site give a museum fire protection and more or less freedom from noise, dirt, smoke, gas fumes, vibration, and other nuisances of cities. And parks offer room for expansion, at least theoretically. But centrally located parks have least of these boons to offer; and outlying parks, besides being too far away, are likely to draw people at times of their chief engagement with picnic baskets. Moreover, popular defense of parks against encroachments of any kind is a familiar and understandable phenomenon. A park, after all, does represent a decision as to land use, and putting a building in it for any other purpose is a reversal of policy.

Fair grounds and zoological parks are sometimes considered for museum buildings. Fairs differ in spirit from museums, and fairgrounds may lie idle during most of the year. A temporary exhibition as part of a fair is the best gesture museums can make in this direction. However, several expositions have included buildings designed to continue as museums, in exposition grounds later to be made over as parks. This happened last at Dallas in 1936. The plan must be judged like other park proposals, by the location of the land. A zoo is itself a museum of a kind, and perhaps partly for this reason the Toledo Museum of Science built in Toledo's zoological park. However, for an art or history museum such a location would not be in the least appropriate.

Certain advantages like those of a good park site, together with other advantages of its own, may attach to a site that faces on a park or public space. Such a site may be highly desirable for its accessibility, and if it fronts on a square it may give the best land choice in town.

Park-like surroundings have been secured by some museums through the landscaping of an ample site. Several recent buildings have full-block frontages and enough depth of land to provide for expansion.

Outlying parks are of course the proper places for local trailside museums. Cleveland has the best examples, which are branches of the Cleveland Museum of Natural History. Little trailside museums are in no sense park encroachments, but contributions to the enjoyment of the out-of-doors.

DOWNTOWN PLOTS are occupied by a great many museums. Such a somewhat-near-business location, it now seems to be agreed, surpasses any other.

In a very large city, where the only point within easy reach of several outlying sections may be in the innermost heart of town, serious problems are likely to be met; but in smaller cities the matter may be easier to settle. The Newark Museum's downtown property is spacious and fairly nuisance-free, though only a few blocks from the congestion area of business. The Portland Art Museum has a block, 200 feet square, just off the central district. And in many other places museums have found similar balances between the good of being within reach and the evil of being in too tight a spot. Where the residential part of town is mostly at one side, the place for the museum is between the homes and the downtown businesses. In any place a museum belongs on a radius to town, not on the circumference.

Civic centers might seem to be just right, but this is not always so. Some civic centers are badly placed from the museum's point of view, and many are nests of politics and government architecture.

Sometimes a museum can have a site of such extraordinary distinction that disadvantages are easily overlooked. Every site has both good points and bad; but a site, no matter how tempting, that seriously threatens the work in view should be rejected. Also if there is promise for the future but not enough of present worth, the site should be passed over. What every museum needs is a fairly large piece of land in a location that is favorable and likely to stay so for the useful life of the building.

THE LAY OF THE LAND on a site is an important indication of the fitness of the place, since it gives many a directive as to the character of the building. The committee and the architect should have at their disposal a full survey that shows the orientation, grade, and configuration of the land, with boundaries and adjoining properties, streets or approaches, nearby buildings, trees and other masses on or near the land, the nature of the soil and of any known rock or water, the whereabouts of sewers, gas and water mains, and electrical lines, sidewalks, curbs, and pavements, data on rights, restrictions, and easements, and all other information that can be secured.

The character of the terrain has influences broadly and on many a detail. A small plot, especially one in a city block, may call for a building of several stories. There are museums at present with five or six floors; and the future will doubtless see others that are higher at least in some part. A large plot raises questions of the building's placement on the land, and perhaps of its orientation. Points of the compass and light conditions that go with them may settle some of these questions, with respect to studios and even offices perhaps as much as with respect to

MONTCLAIR ART MUSEUM, ON SLOPING LAND THAT EXPOSES THE BASEMENT AT THE SIDES AND REAR

exhibition spaces. The geology of the place may determine construction methods, especially if there are buried masses of rock or undersurface waters. The foundation of the Avery Memorial at Hartford had to be extended well below the ground-water table and the basement floor of the building was reinforced with steel against bulging from upward pressure of water. Sometimes man's own earlier improvements such as streets and sewers help the builder, but often they hinder him. All such matters must be studied as an early step in designing.

Most museums are on level ground; but sometimes an uneven site is used to great advantage. Land that falls away sharply to the rear may provide for a service entrance directly at basement level. The art museum of the Rhode Island School of Design, in Providence, achieves simple modesty in a one-story front elevation, and yet from this level downward it has actually a five-story structure looking out at the rear. Rising land is awkward because it reduces workable volume and gives buried points where rear entrances should be. The Southwest Museum, Los Angeles, has a hilltop building, reached by a tunnel into the hill and an elevator. Whatever the value of view, a conspicuous location, and perhaps novelty, there is a greater advantage for museums as a rule in being conveniently placed.

RELATION TO STREETS, on one or several sides, is ever a vital matter that grows more important still as museums move into busier parts of town.

Traditionally, museums have presented a long façade in the direction of main approach, but with the changing character of sites a narrow face is now often put to the street. In any case, quite naturally it would seem, the front should be in front; but there is another arrangement, common among art museums, that faces the building toward a park or vista and turns to the main throng of visitors what is really the back of the building with its basement entrance made presentable. This scheme traces from conditions of the past as we shall see in Chapter IX.

The service entrance, usually at the back or side of the building, looks for its traffic to a driveway approaching as a rule from side or rear, or sometimes from the front; but several museums close to other buildings on their flanks have the service driveway passing in apartment-house fashion through the street façade. The requirements (page 189) are ease of access, space enough to accommodate cars and trucks, and all possible screening for outdoor operations by the building itself or by walls or the land or its plantings.

A plot bounded by four streets or in the arms of two or three streets is likely to offer many advantages, but should be studied for any limitations it may set on enlargement of the building. Small sites on busy streets have obvious counts against them, but they encourage practical planning for a reasonable term of occupancy.

Buildings set only a little way back from the street, with a narrow lawn or modest plantings in front, are fairly numerous. Sometimes the character of adjoining properties prompts this arrangement, which seems to partake of both the accustomed atmosphere and the new spirit of museums.

More and more, however, one sees museums fronting at the sidewalk line of a city plot. The Museum of Modern Art and the Grand Rapids Public Museum are notable among a score or more of examples. Libraries know the importance of being close to the passing people and of having a busy interior well in sight. Museums are taking this cue;

HEADING FAIRMOUNT PARKWAY ON A MAIN AXIS OF THE CITY, THE PHILADELPHIA MUSEUM OF ART. HORACE TRUMBAUER, C. L. BORIE, C. C. ZANTZINGER, ARCHITECTS

at Springfield in Massachusetts, for instance, one can look through Chestnut Street windows into the workings of the Museum of Fine Arts. Many a lobby might thus be seen to advantage if its museum were better placed; and many another lobby might perhaps be put to livelier use if the public could easily inspect it.

SIDEWALK DISPLAY, having only one permanent museum example so far, is taken practically for granted in the planning of museums now projected. Public libraries made their first venture in this direction as early as 1920; and many recent libraries, notably those of Grand Rapids, Cleveland, Birmingham, and Baltimore, have show windows looking onto the sidewalk. The first museum building with such windows is that of the Grand Rapids Public Museum, completed in 1940. It has five windows, two flanking the entrance and three facing the side street. This example has already done a great deal to promote planning of buildings with main entrances near curb level and close to the sidewalk.

On the construction of show windows there are notes in another chapter (page 234). Windows facing north are advantageous since they give no trouble from fading or overheating by the sun; east exposure is better than west as a rule since it does not have afternoon sun. Inconspicuous awnings, in keeping with the design of the building, are suggested for libraries by Wheeler and Githens. However, the projected Indiana State Museum will have windows at the back of a narrow portico, skirting the sidewalk, where they are protected from the sun.

PARKING is a problem of varying seriousness depending upon the location. For the staff at least there may have to be a private parking space. Many museums use the service area for this, in which case the staff size gives the clue to the number of places required. The space should be arranged in such a way that delivery trucks will not damage the cars of staff members by backing into them. Basement parking is not good, if only because museums need their basement space for other purposes.

Some museums have parking space for the public. Some have vacant land nearby, or are where it is easy to park. But many museums do as libraries do, letting the driving visitor shift for himself. The worst trouble with this is at night, especially when it rains.

SITE PLANNING is a concern of the architect. Without the architect's counsel, the treatment of even a favorable plot may undo the best of designs.

Some devices of landscaping are like intimate parts of the building. The terrace is one of these. A building set behind a lawn may be saved from having front steps by a terraced approach. The Buffalo Museum has three such rises in front, largely overcoming the position of the entrance which is some ten feet above the sidewalk grade. The Cranbrook Academy gains in distinction through having an approach with terraced reflecting pools. However, such an approach to a building must not be the only approach. The main entrance drive should go to the main entrance, not to the foot of a stepped path that may stop handicapped people and that exposes everyone to inclemencies of weather. Sometimes a descending step of land alongside the building, perhaps with a parapet, is useful for screening a service drive at the rear.

Drives and walks should not fail to respond to ordinary practical needs while meeting needs of the design. A nonfunctional path may be as bad as an unsightly one. Ill-considered placing of walks, like omitting of walks, leads to cowpaths. One of the commonest omissions is a way of getting around a large building from front to back without a maddening excursion. This is not overcome by having a raised shelf at the base of the building, around the outside. Children find such a circuit much too attractive for running on, noisily.

Quartz gravel on paths cleans the shoes of visitors and keeps down the tracking of mud.

Plantings, near a building and in open courts, may be both pleasing and useful. Greenery should be simple, and not too expensive to keep up properly. Plants may well be selected for their interest in winter as well as in summer. Massed plantings are often employed to screen side or rear exposures of basement. Trees, which are much faster cut than grown, should never be taken off a site hastily in preparing to build.

Outdoor spaces are sometimes developed in practical ways. A fairly common use of such spaces among art museums is for showing sculpture, whether fixed pieces or objects in a temporary show. Science and history museums also are likely to possess things of interest that are appropriate for installing in the open. Protection against vandalism may have to be part of the planning for such installations.

Public libraries in the South and West provide canopied reading spaces on terraces or in patios, and this arrangement should be suggestive for museum reading rooms. Even in colder climates an outdoor space has uses in season. At Detroit and Boston garden courts are convenient at times in entertaining large groups.

CHAPTER VI. CHARACTER AND STYLE

Architectural fitness depends, by a defining principle of architecture, upon the justice of relationships between different sides of a building's nature. The materials employed, the structure made of them, and the forms and spaces so evolved must reckon on the one hand with the practical purposes of the building and on the other with aesthetic effects. Through means at the architect's disposal the building thus becomes at once a thing of utility and a creative work. The manner of this whole expression is architectural style, which is no less than a summation of the building's character as shaped by circumstances of its time and place in the world. However, what is often called style is in fact embellishment, applied to surfaces like make-up. Such stylistic adornment may be suggested by the true style of the age, or by the style of some earlier age remembered in history and recorded in old buildings. Great styles of the past, say the Greek or the Gothic, at their height have shown close integration of all elements in the nature of buildings. At other times there have been evidences of a split between structure and stylistic treatment. When functions of buildings are in most rapid flux there is likely to be the widest gap; and this condition is sure to be recognized, sooner or later, as an architectural fault.

STYLES OF THE OLDER MUSEUMS had to be based on historical styles, because museums grew up in a period when there was nothing but the derivative in the architect's repertory. Pilgrim Hall, first society museum building, at Plymouth, Massachusetts, was a Greek Revival temple of 1824. Earlier buildings at Philadelphia and Baltimore (see page 255) were Classical in the Early Republic manner. And the first college museum building, Yale's Trumbull Gallery of 1832, was of the Greek Revival. Surprisingly, perhaps, it was at this time that Europe saw its first important museum construction, giving the Altes Museum (1824–28) in Berlin, the oldest block of the British Museum (1825–27), and then the Glyptothek and old Pinacothek in Munich and the National Gallery in London, all of them monuments of the Greek Revival.

In our own country, a new revival—the Gothic—was under way by the early 'forties; and this had as its first museum example the Wadsworth Atheneum at Hartford, completed in 1844. This romantic movement was soon notably represented also by Renwick's Smithsonian Institution, an "ecclesiastical Norman castle," of 1855.

Next there were palace-like museums over here, beginning with the old Corcoran Gallery at Washington, finished though not opened in 1859. The Corcoran building was a provincial re-echoing of the Renaissance, unmistakably based on the Palace of the Tuileries in Paris.

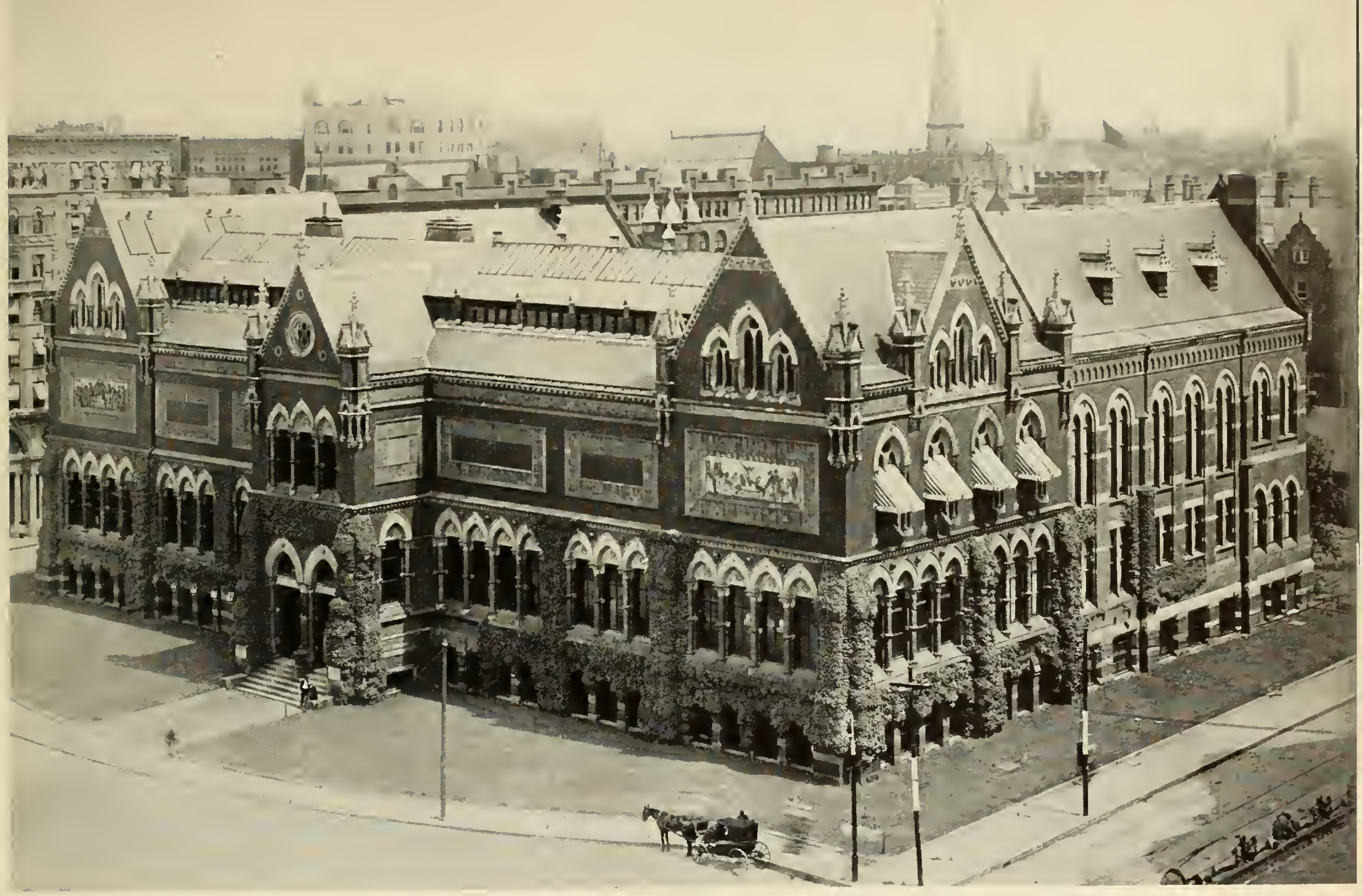
During the 1870's a Boston group made our first careful examination of what the Old

PILGRIM HALL OF PILGRIM SOCIETY MUSEUM, PLYMOUTH (1824) ALEXANDER PARRIS, ARCHITECT

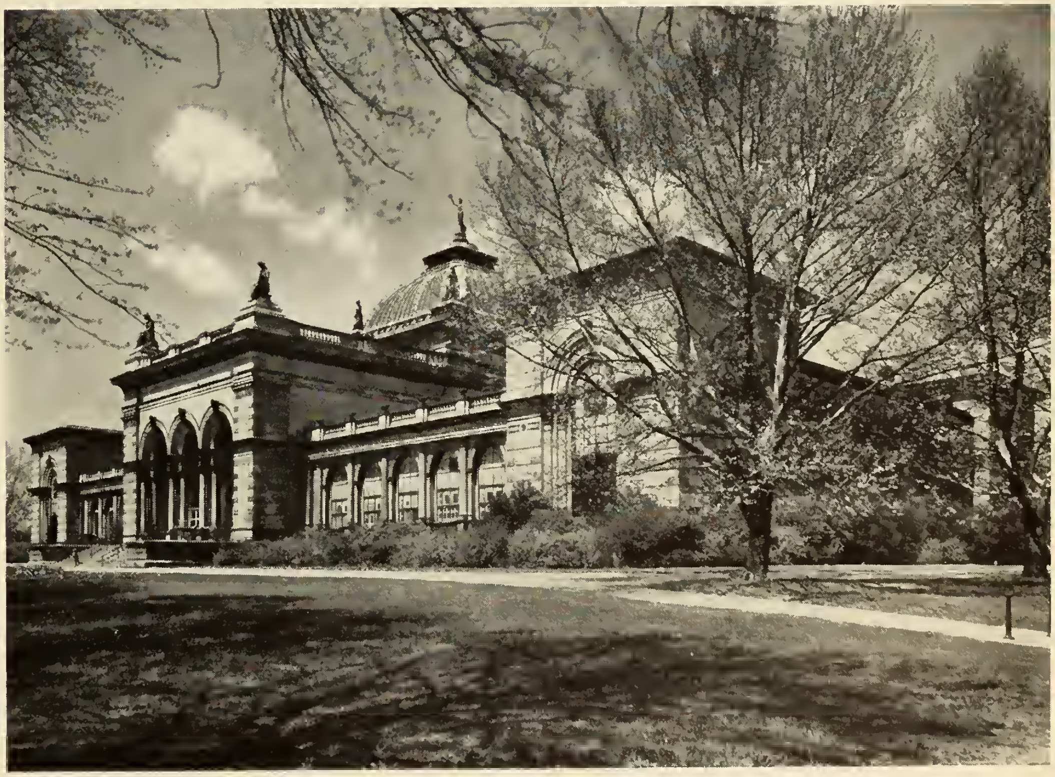
SMITHSONIAN INSTITUTION, WASHINGTON, D. C. (1855) JAMES RENWICK, JR., ARCHITECT

World had been doing, and the outcome in 1876 was Sturgis' Copley Square building of the Museum of Fine Arts. This structure, long since demolished, was in Victorian Gothic of an Italian leaning; and it marked a step in advance since in plan and elevation it showed direct influence not of temples or castles or palaces but of museum buildings that had combined traditional spirit with useful provisions, as given by Von Klenze in Munich and Friedrich Schinkel in Berlin. The year 1876 also brought to completion Victorian Gothic buildings for Philadelphia's already old Academy of Natural Sciences and Academy of the Fine Arts. And more important still, it produced the earliest art exhibition building for large crowds, Memorial Hall of the Centennial Exposition. This 19th century Philadelphia version of the Renaissance bore resemblances in its plan to Semper's Dresden Gallery of 1854. The Centennial building was notable as a forerunner of the large exposition-like museum buildings that New York and Washington would start in the late 'seventies and early 'eighties. Schemes for great pavilions embracing courts were contemplated in the beginnings of the American Museum of Natural History (first unit 1877) and Metropolitan Museum of Art (first unit 1880); and a somewhat similar plan was carried out in Victorian Gothic for the U. S. National Museum building of 1881.

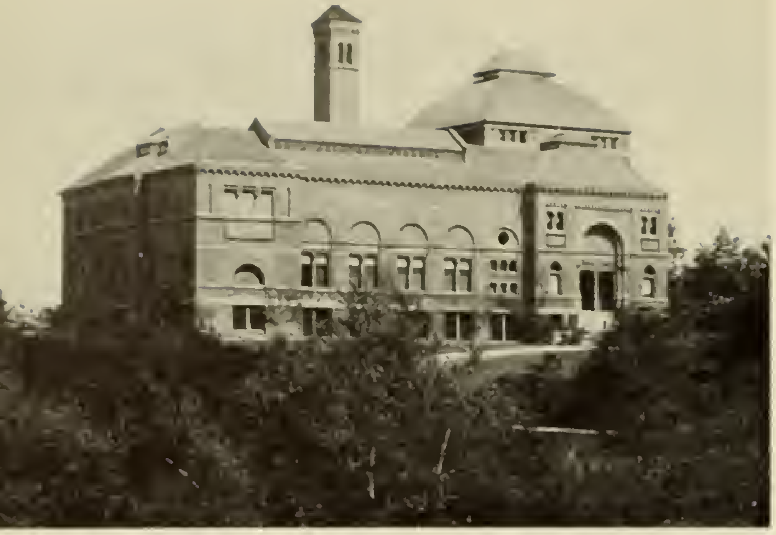
FIRST BUILDING OF CORCORAN GALLERY OF ART, WASHINGTON, D. C. (1859, OPENED 1874) JAMES RENWICK, JR., ARCHITECT



(ABOVE) FIRST BUILDING OF MUSEUM OF FINE ARTS, BOSTON, MASS. (1876) JOHN H. STURGIS, ARCHITECT



(RIGHT) MEMORIAL HALL, PHILADELPHIA, PA. (1876) HERMANN JOSEPH SCHWARTZMANN, ARCHITECT



CINCINNATI ART MUSEUM, OHIO (FIRST BLOCK, OPENED 1881)
J. W. MC LAUGHLIN, ARCHITECT

These projects were reminiscent of London's Crystal Palace of 1851 and were influenced also by the later fair structures of London, Paris, and Vienna.

Architectural eclecticism of the 'sixties and 'seventies called upon a widening range of sources for its borrowing and combining; but, partly because museums had not yet begun to be built in large number, museums suffered less than some other kinds of buildings from the bad taste and the license of the times. An indescribable brick pile of a museum was put up here and there, as at Cambridge where there were periodic additions to an 1860 beginning. Also a few museums appeared with Mansard roofs. But museums shared very little in the general vulgarization of French Second Empire influence—and this was all the more remarkable since an important source of the style was the Louvre as extended under Napoleon III.

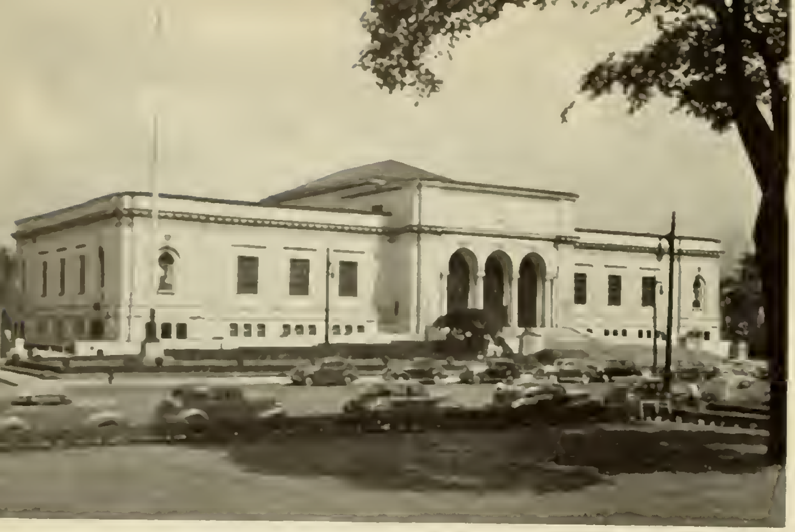
However, museums took their full part in the fad of Richardsonian Romanesque which, from the 1880's, gave so many public buildings that were ponderous, awkward in arrangements, and bad in lighting. The Cincinnati Art Museum of 1881 was the first notable Romanesque museum, and among others that soon followed were a history and an art museum in Chicago and an art museum in Detroit, and the 1888–97 block of New York's American Museum.

Beginning in the 'nineties, two waves of Classicism swept over the country, carrying museums with them all the way to the rise of modern style and a little beyond. The first wave, using Renaissance forms in more or less strict accordance with Beaux Arts teachings in Paris, brought an early example in Rutan, Shepley and Coolidge's new building of 1893 for the Art Institute of Chicago, an Italian Renaissance museum with a staircase of truly grand proportions. In their adoption of this style the architects seem to have been prompted by the design of Semper's Dresden Gallery, which had broken away from the Greek Revival of its German predecessors and had followed the Italian Renaissance. But in any case the Chicago building was itself an influence through four decades during which there came Renaissance museums, some of French derivation like the new Corcoran Gallery (1897) at Washington, others Italian like the Walters Gallery (1909) at Baltimore and the Morgan Memorial (1910) at Hartford, and, later still, others Spanish like the Fine Arts Gallery of San Diego (1926). Platt, who had seen in Italy that a villa is a house together with gardens, included a formal garden court in his Freer Gallery (1923) at Washington, thus affecting museums at Detroit, Dayton, Columbus, and some other places. Meanwhile several architects had shifted their attention to Post-Renaissance France, and had given designs recalling Perrault's façade of the Louvre and the palace of Versailles; but this phase, with its monumental features of the Baroque, became confused with an advanced stage of the other wave of Classicism.

The second wave stemmed from Chicago's Columbian Exposition of 1893. Attwood's Fine Arts Building of the Chicago fair, based on a Prix de Rome design by Besnard, harked back to the ancient monuments. This and other buildings of the exposition in effect turned the whole country's interest to Neo-Classicism, bringing forth a generation of monumental construction. In 1902 the Metropolitan Museum added to its earlier Victorian Gothic structure a million-dollar Roman bath as the main block of a new front on Fifth Avenue. McKim, Mead and White, who had given the exposition its much remarked Agricultural Building, became the Museum's architects and developed projects for north and south extensions recalling Robert's famous design of a century earlier for partial remodeling of the Louvre. Science museums were led also by the exposition, partly no doubt because Attwood's Chicago building soon became the first home of the Chicago (then the Field) Museum of Natural History, and partly through further works of McKim, Mead and White including the Neo-Classical Brooklyn Museum (1895), then largely devoted to science. By the time monumental museums had been put up in several state

ART INSTITUTE OF CHICAGO, ILL. (1893) RUTAN, SHEPLEY AND COOLIDGE, ARCHITECTS

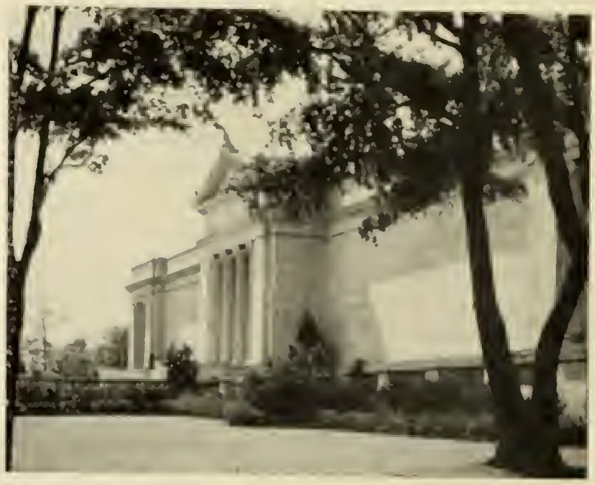
FINE ARTS BUILDING OF WORLD'S COLUMBIAN EXPOSITION, CHICAGO (1893) CHARLES B. ATTWOOD, ARCHITECT. NOW RESTORED FOR MUSEUM OF SCIENCE AND INDUSTRY



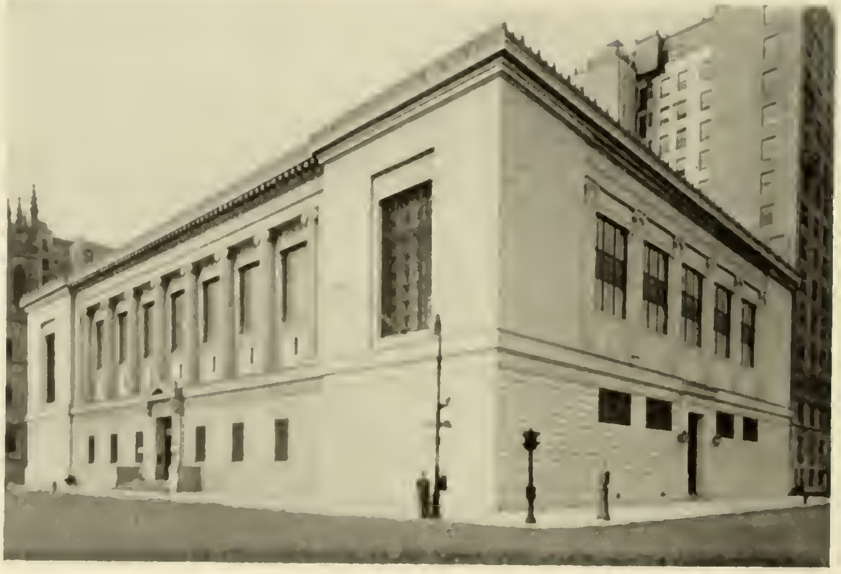
DETROIT INSTITUTE OF ARTS, MICH. (1927) PAUL P. CRET, AND ZANTZINGER, BORIE AND MEDARY, ARCHITECTS

capitals, as at Albany (1900), and the National Museum had built its new natural history building (1911), Neo-Classicism was firmly established as the government style. Meanwhile, with communities embellishing themselves after the fashion of Haussmann's Paris and Burnham's schemes for Chicago and San Francisco, it was natural for new local public museums everywhere to fall into line. At St. Louis there had been another exposition in 1904, adding its weight through an Art Building—later the City Art Museum—laden with sculpture. Besides such florid buildings of the time, there were more nearly academic uses of Greek forms that gave a series of Neo-Grec museums like the New York Historical Society (1908). And there were also some quite direct uses of Greek temple and stoa motifs, witness, the Doric Buffalo Historical Society (1902) and the Ionic Albright Art Gallery (1905).

Thus the Greek temple, the Roman public edifice, the Mediaeval castle, and the Renaissance palace had taken their places as patterns for museums to follow and follow again.



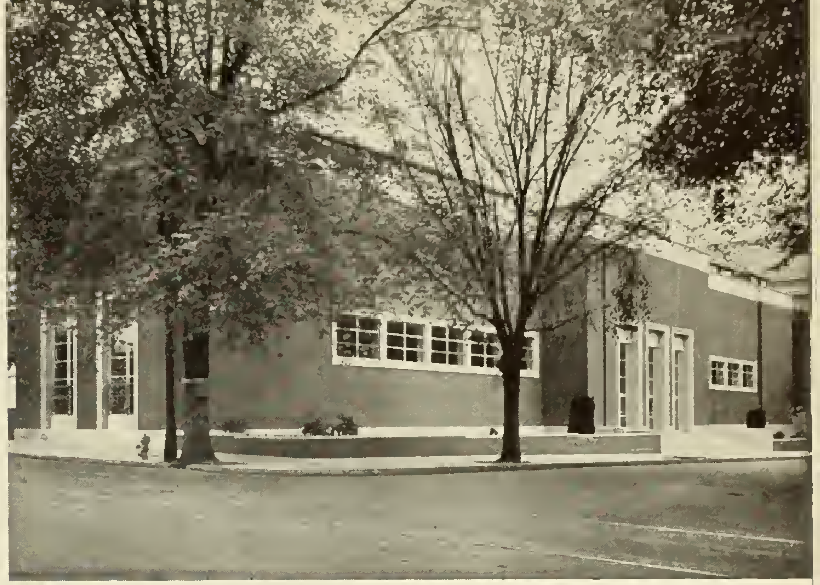
CLEVELAND MUSEUM OF ART, CLEVELAND, OHIO (1916) HUBBELL AND BENES, ARCHITECTS



NEW YORK HISTORICAL SOCIETY (MIDDLE BLOCK 1908) YORK AND SAWYER, ARCHITECTS OF FIRST BUILDING

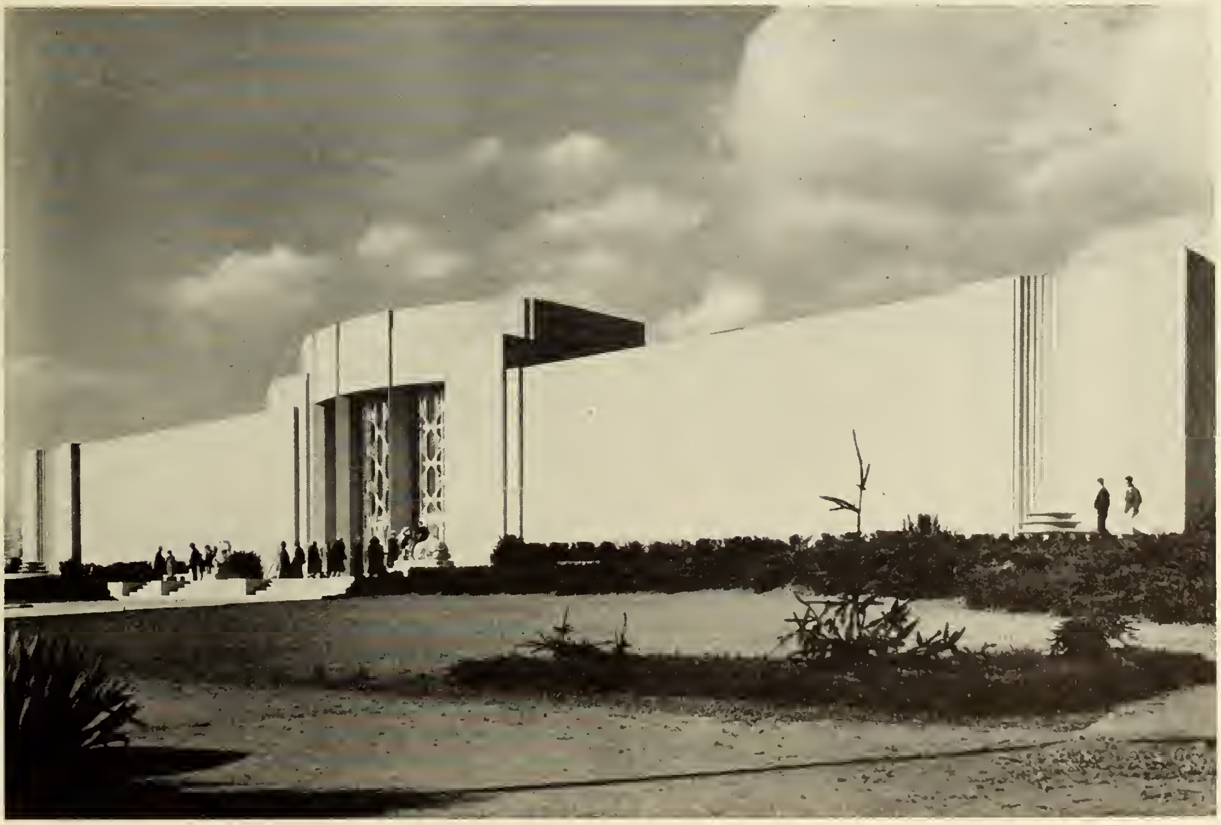
STYLES OF RECENT MUSEUMS show a strikingly different pattern from the styles of older museums, in consequence of the adoption of modern style. This change took place decisively in 1933, although it had been well marked during the 'twenties in other fields of building.

Before 1933 there was little hint among museums of what was to come. To be sure, the Newark Museum, in the flexibility of its arrangement, showed a fresh spirit as early as 1926; and in 1931 the Joslyn Memorial at Omaha showed a different though related freedom in its simple façade and primitive ornamental themes. But only two buildings of 1932, namely the West Coast art museums of Seattle and Portland, seem unmistakably to be part of what happened the next year.


MUSEUM OF ART, PORTLAND, ORE. (1932) PIETRO BELLUSCHI OF A. E. DOYLE AND ASSOCIATES, ARCHITECT

The change of 1933 was a veritable landslide to the modern. Up to that year museums in one or another version of Classical, Mediaeval, and Renaissance styles had appeared regularly and in numbers; but from 1933 on, year after year, came so many modern mu-

SEATTLE ART MUSEUM, WASHINGTON (1932) CARL F. GOULD, ARCHITECT



AVERY MEMORIAL OF WADSWORTH ATHENEUM, HARTFORD, CONNNECTICUT (1934) MORRIS AND O'CONNOR, ARCHITECTS

seums that by the time construction came to a halt in wartime 1942 there were upwards of 50 moderns, including a score of important public museums. During this last decade, the only new Classical buildings were those of the Franklin Institute in Philadelphia, the art museums of Kansas City and San Francisco, and the great National Gallery. There was not a single new building in Renaissance style. And the only new Mediaeval building, The Cloisters in New York, was so designed as a setting for authentic Romanesque and Gothic architectural parts.

The building that stands out as the most direct pre-war expression of modernism, and that is still the largest and best known of its kind, is New York's Museum of Modern Art (1939, Philip L. Goodwin and Edward D. Stone, architects).

Other notable examples of the modern are, besides the forerunners already noted as at Portland and Seattle, the art museum buildings at Hartford (1934, Morris and O'Connor), Colorado Springs (1936, John Gaw Meem), Dallas (1936, De Witt and Washburn, with Paul P. Cret, consultant), West Palm Beach (1941, Wyeth and King), and Des Moines (1948, Saarinen, Swanson and Saarinen); the art and science museums of Cranbrook, Michigan (1938 and 1942, Eliel Saarinen); the recent science museums at Grand Rapids (1940, Roger Allen), and Highlands, North Carolina (1941, Alfred Kastner), and the museum of science and history at Rochester (1942, Kaelber and Waasdorp).

Additions made to older buildings from 1933 onward gave evidence of the difficulty under which building committees and architects labored. Where existing structures in styles of the past had to be agreed with, new wings as a rule made concessions to them however grudgingly. At Cincinnati, where the Alms Wing of 1937 completed the Romanesque façade of 1881, "the Trustees felt that any change of style would necessitate a change of the whole façade . . . at the present time . . . not financially possible." Elsewhere there were "modified" and "restrained" Renaissance additions to older Renaissance

COURT OF AVERY MEMORIAL, HARTFORD, CONN.
Courtesy Wadsworth Atheneum

HIGHLANDS MUSEUM OF NATURAL HISTORY, N. C. (1941) ALFRED KASTNER, ARCHITECT

DALLAS MUSEUM OF NATURAL HISTORY, TEX. (1936) LEMMON, GRIESENBACH, DANNA AND KEAN, ARCHITECTS

buildings, and "free" and "adapted" Classical additions to older Classical buildings. Nevertheless, some museums did make a clean break with the past by adding or remodeling in modern style. The Springfield Museum of Natural History did both at once in 1934. At Hartford, the Wadsworth Atheneum put the modern Avery Memorial beside its older Renaissance Morgan Memorial in 1934. Chicago completely reconstructed the interior of its Neo-Classical Fine Arts Palace of 1893, giving a quasi-modern setting for the Museum of Science and Industry. The Brooklyn Museum cut all it could from its

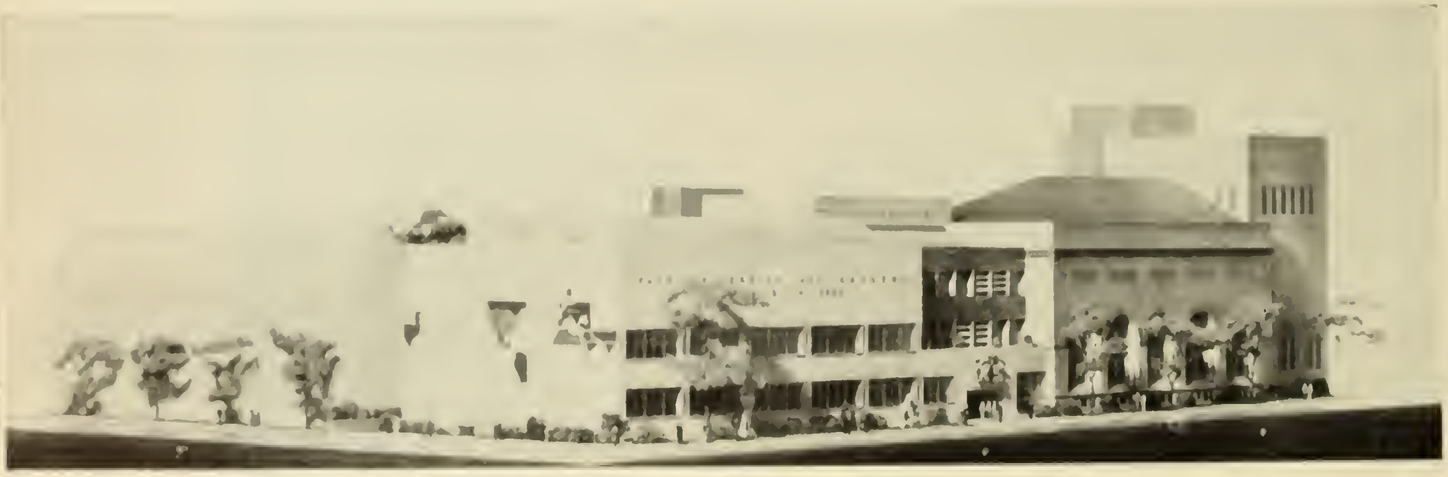
CRANBROOK ACADEMY OF ART BLOOMFIELD HILLS, MICH. (1942)
ELIEL SAARINEN, ARCHITECT

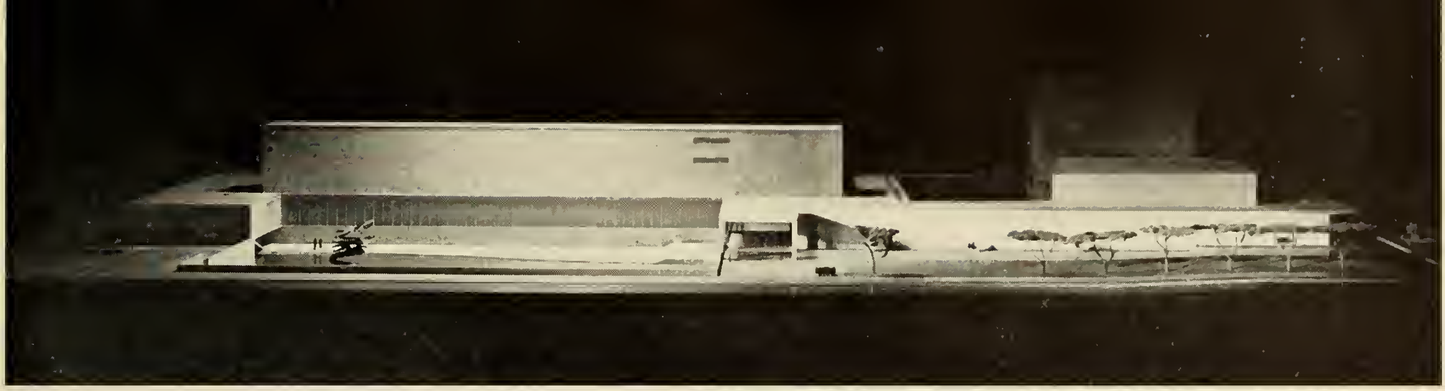
HAYDEN PLANETARIUM OF AMERICAN MUSEUM OF NATURAL HISTORY (1935) TROWBRIDGE AND LIVINGSTON, ARCHITECTS

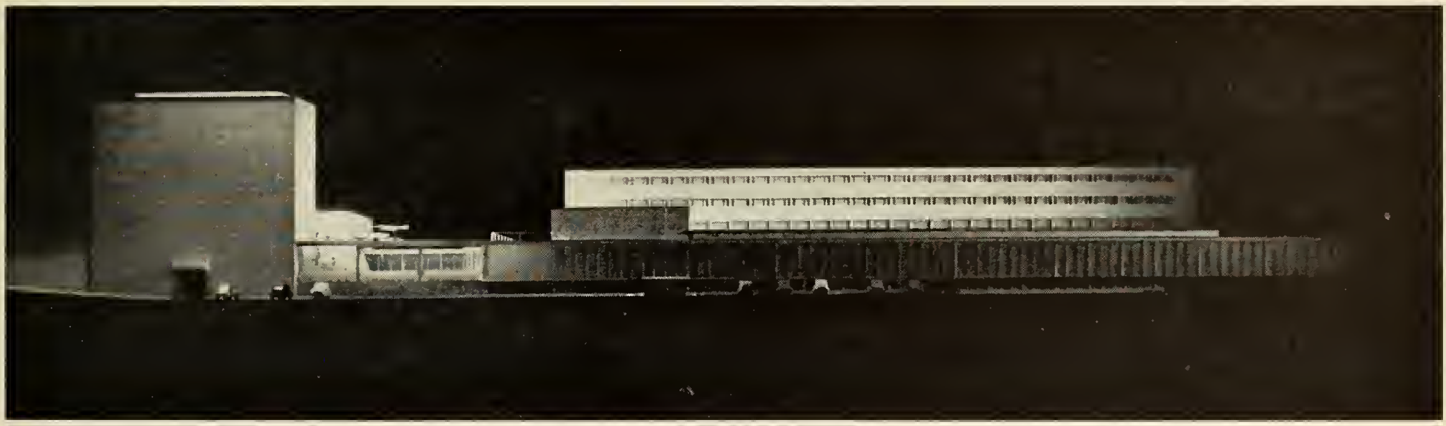
Neo-Classical porch of 1895, and remodeled its principal interiors in a most modern-looking manner. And the American Museum of Natural History added two near-modern wings and the modern Hayden Planetarium to its assemblage of structures that had been started in Victorian Gothic (1877), continued in Romanesque (1888) and Neo-Classical (1936), and would soon be wholly remodeled, according to rumor, in the style of today. On the other hand, the Toledo Museum of Art had to stand by Greek beginnings of 1912 when it completed its building in 1933, and a dozen smaller buildings also were enlarged without change of style.

During and after the war some important projects not yet carried out have been developed. In 1939 came the premiated design for a Smithsonian Gallery of Art by Eliel and Eero Saarinen and J. R. F. Swanson. Two modern state museum projects were announced, for Illinois (Department of Architecture and Engineering, C. Herrick Hammond, supervising) and for Indiana (Walter Scholer and Beine, Hall and Curran). The Junior Museum, San Francisco, made public preliminary plans by William G. Merchant, C. Hathaway Lovell, associated. The Brooklyn Children's Museum, marking its fiftieth year, announced plans by Brown, Lawford and Forbes. Yale University's Gallery of Fine Arts proposes to add a modern block of buildings by Philip L. Goodwin to its near-Gothic block. Among many others are the Boston Museum of Science (Ames, Child and Graves), Milwaukee Public Museum (Eschweiler and Eschweiler), Detroit Historical Museum (William E. Kapp), and Guggenheim Museum (Frank Lloyd Wright).

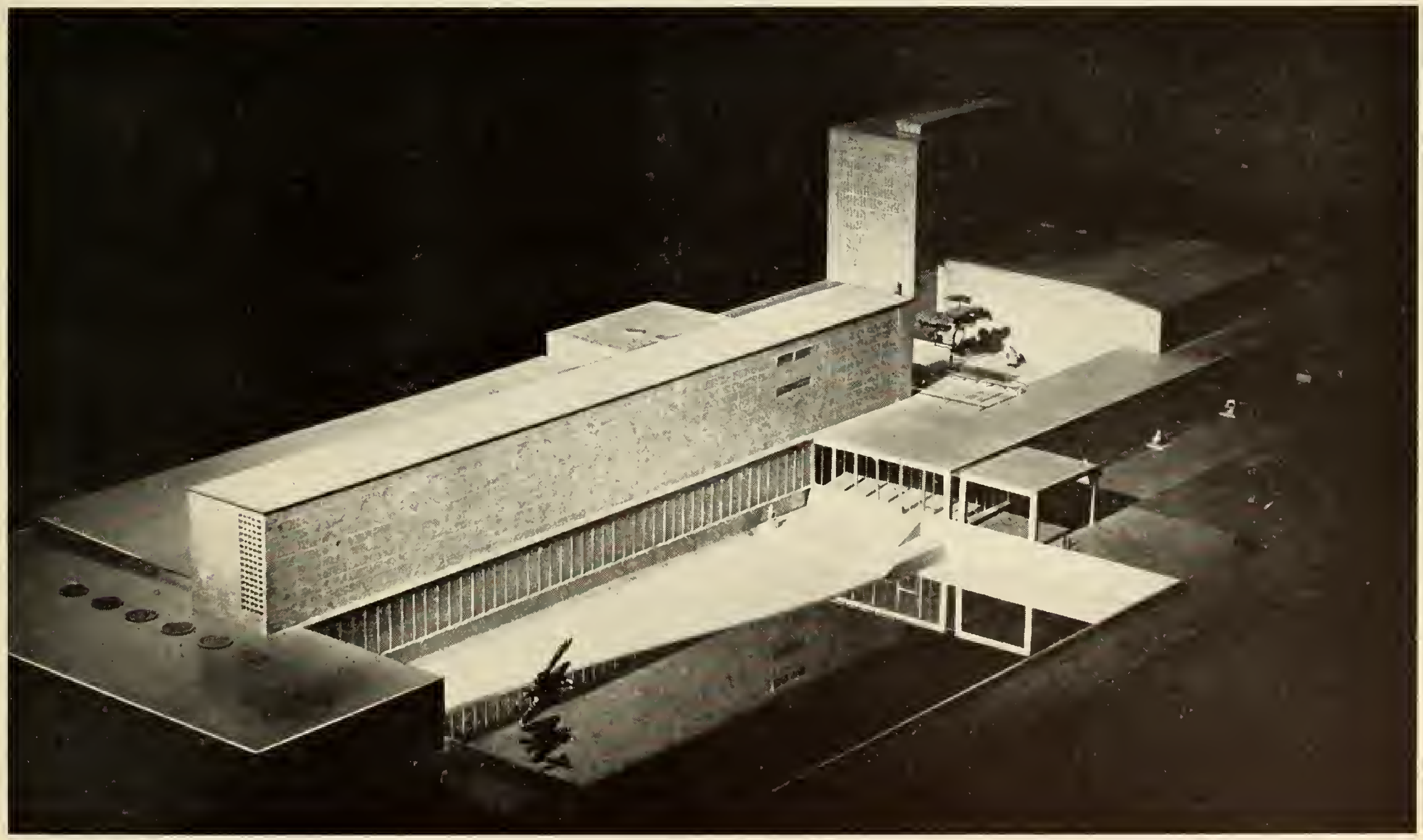
YALE UNIVERSITY ART GALLERY, MODEL OF PROJECTED MODERN ADDITION (CENTER)
PHILIP L. GOODWIN, ARCHITECT. PRESENT BUILDING (1928) EGERTON SWARTWOUT

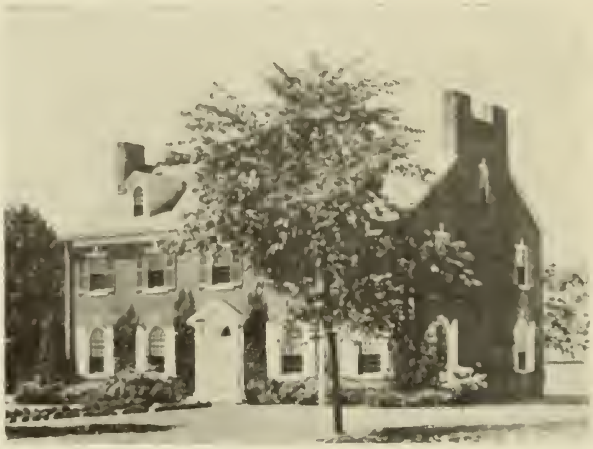






MODEL FROM PRIZE-WINNING DESIGN (1939) FOR A SMITHSONIAN GALLERY OF ART
ELIEL AND EERO SAARINEN AND J. R. F. SWANSON, ARCHITECTS



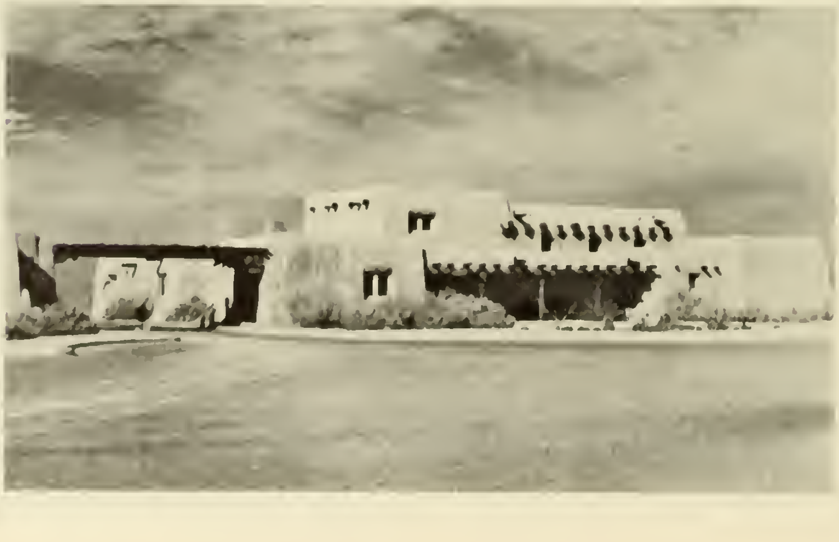


MONMOUTH COUNTY HISTORICAL ASSOCIATION, N. J. (1931) W. H. AND J. H. CONOVER, ARCHITECTS

Meanwhile, and apart from these events, there has been another current in the style treatment of museums that has continued to flow with growing strength from beginnings at about the turn of the century. This is the employment of *early American types*—principally 18th century English Colonial or "Georgian" in the East, and Spanish Colonial or "mission" in the West, together with adaptations of indigenous styles including the Santa Fe version of Pueblo. The early American and the modern are now represented about equally among museums. However, there is marked difference between the kinds of buildings concerned; most of the examples of American styles are small museums, most of them historical, whereas the moderns are of all kinds, and are typically larger museums.

It is not surprising that there should be many little historical museum buildings of colonial types. The Georgian period is of especial interest to historical museums in the East, as the period of the early missions is to historical museums near the West Coast. Colonial buildings usually fit into the small-town scene, they call for appropriately simple building materials, and their stylistic features tend to be of the most restrained character. It is of interest also that some of these so-called colonial buildings, in particular those of Spanish flavor in California, are not far removed in some ways from a present-day species of domestic cottage that has been characterized as a "native and humane form of modernism." And, by the way, this might be said also of some of the little trailside museums, like rustic cottages of local materials, that are appearing in many of the national and state parks.

Local color has come out in another way among small museums—representing foreign-



WHITE SANDS NATIONAL MONUMENT MUSEUM, N. MEX. (1940) NATIONAL PARK SERVICE, ARCHITECTS born elements. For example, at Sturgeon Bay in Wisconsin there is the Door County Historical Society with Bernhard's apt use of a Scandinavian motif. At Ste. Genevieve in Missouri there is the Ste. Genevieve Museum with a little building of French provincial type. And at Lancaster, Pennsylvania, the local Dutch influence was followed for the Landis Valley Museum.

However, these are lesser currents, running beside the main stream of present-day museum designing in contemporary style.

DOOR COUNTY HISTORICAL SOCIETY, STURGEON BAY, WISC. (1939) WILLIAM J. BERNHARD, ARCHITECT

CRITICISM OF THE OLD, which took a most unfavorable view of things during the 'twenties and early 'thirties, can still be useful since it throws light also on some problems of today.

What was most wrong with the older museums, by common consent, could be traced to the preoccupation of designers with certain stereotypes. There was the family of massive Neo-Classical buildings in which features of ancient monuments were variously combined in rigidly symmetrical ordering. These structures had long flights of approaching steps, porticos with colossal orders, colonnaded façades with massive entablatures, ponderous vaults, perhaps a domed rotunda, and great pavilions formally disposed on main axes, all constructed in heavy masonry with thick walls, large piers and arches, more columns, entablatures, and pediments inside and out, coffered ceilings, and a profusion of kindred detail. There was also, as we have seen, the family of palace-like buildings, usually for art museums, in adaptation of Renaissance and Post-Renaissance examples. These had bilaterally balanced plans and conventional, little varied, room arrangements, sometimes with a grand entrance hall and staircase, cloistered and double cloistered courts or colonnaded halls, and period ornamentation.

The most obvious trouble with this entire program has been that the stylistic paraphernalia has seriously hampered museum functioning. Exterior colonnades, for instance, dictate arbitrary fenestration and cut off light from the windows. Interior columns, pilasters, and panels stand in the way of needed practical arrangements and thwart rearrangements; and they interfere with installing of exhibits, to say nothing of their competition with exhibits for attention and their clash with most exhibits in spirit. Buildings in which the main axial block is of monumental proportions, perhaps with a great vaulted chamber or domed rotunda, give large scale demonstrations of lost opportunity. The vast central space in such a building may have massive piers, columns, or superimposed orders that rise through several stories, bounding what might have totaled half an acre or more of space unrivalled for museum usefulness as well as for inspiration. Passing over questions of cost, which have to do with enormous sums, such architectural displays are widely condemned as being themselves unrewarding and as standing in the way of what should be among the museum's most telling features.

Buildings in derivative styles, as these styles are employed for museums, have suf-

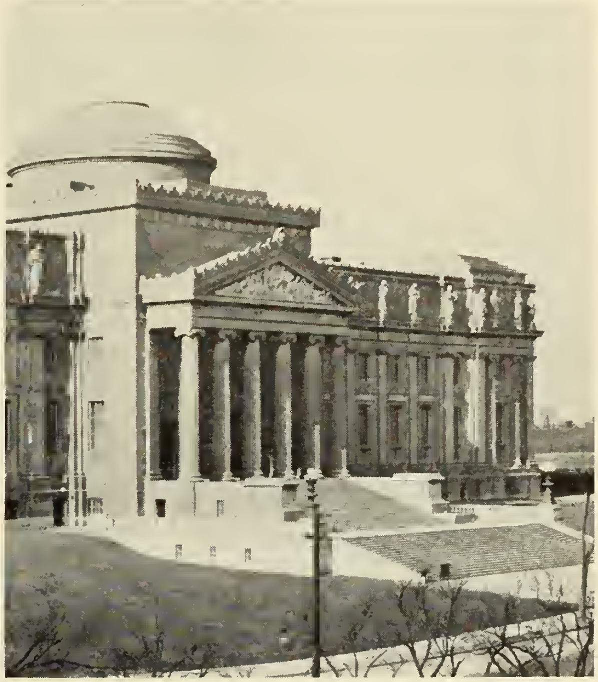
INTERIORS OF CLASSICAL BUILDINGS: (ABOVE) AT CINCINNATI, AND (BELOW) AT KANSAS CITY, MO.

fered also from traditional emphasis on the second floor, and the consequent call for an outside flight of approaching steps in a Neo-Classical building or an indoor great staircase in a building of adapted Renaissance design. In the middle 'thirties, the Brooklyn Museum faced the fact that, in museum economy, the second floor is not the principal floor. It simply demolished the exterior steps of its troublesome Neo-Classical building, and made the basement into the main floor with a redesigned main entrance at ground level. Some other museums with the same problem have had to take the second-floor entrance out of use, as at New York's American Museum where the great double flight of steps remains as a vestige. Museums have not been alone in this difficulty; to be seen everywhere are public and semi-public buildings of the turn of the century with ghost porches and improvised basement portals the absurdity of the condition tempered only by its familiarity. However, palace-like museums, with featured staircases inside, have had no escape whatever. From the 1850's when the old Corcoran Gallery essayed the palace form, and especially from 1893 when the Art Institute of Chicago adopted a wholly monumental staircase, until the 1930's came repeated examples of this Baroque feature which has been known to fill a lobby as an open stepladder fills a closet.

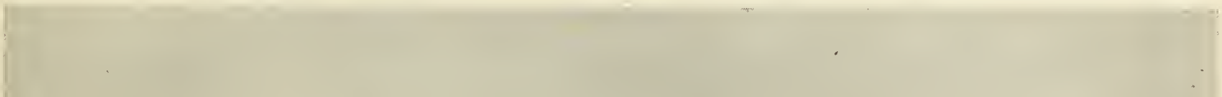
Large scale, of itself and apart from architectural accompaniments of the past, may or may not be awkward; but great rooms of traditional character are difficult to put to museum use. Enclosed courts now stand sometimes almost empty, sometimes half occupied by tapestries or sadly held by casts. Directors have shown ingenuity in making basilicas and halls of honor serve as extra lobbies, special exhibition galleries, and places of assembly; but such opportunism has had hard going in the face of conventional forms.

Bilateral symmetry in plan and front elevation, along with horizontality and regular ordering of façade, had been laying down the rules for so long under the old regime that planners had forgotten to ask what they really wanted, and always began by accepting what was thrust upon them by style. From the building committee's first crude sketch to the architect's finished drawings, unspoken regulations said what could and could not be done in shaping the building and arranging its space divisions.

Some Classical buildings, to be sure, did not suffer as much as others because their designers treated style as mere superficial trimming. Thus it has been possible to put some well planned interiors into formal old containers. However, by so doing museums have had to subscribe to the serious error that the architect's opportunity as a designer is solely or mainly on the outside of the building, thus ignoring the fact that integrity of exterior and interior is essential to sound



BEFORE AND AFTER RELOCATION OF ENTRANCE AND ELIMINATION OF STEPS (1935). BROOKLYN MUSEUM, N. Y. (1895) MC KIM, MEAD AND WHITE



design. Denial of this principle is what sometimes makes so maudlin the effort to screen a modern interior with a façade that is foreign to it. Compromise of this sort is like falling between two stools, since the resulting building can be true neither to the past age which it partly avows nor to the present which it tries to serve.

A forceful criticism, from the museum point of view, has been brought by curators who object to stylistic interiors on aesthetic grounds. It has long been an accepted tenet of museum exhibition that a manufactured period setting is inappropriate for an authentic period display, even though the two are in keeping stylistically. In the light of this view there is not much to say for the often repeated idea that a Neo-Classical building is the most fitting home for objects of Classical art. Moreover, art museum collections are not now primarily Classical but of very wide provenience, and therefore not capable of fitting into any period building even though the building could be in truth an authentic piece. And in a science museum if there should be Greek columns as background for say New World fauna, the trouble would be apparent.

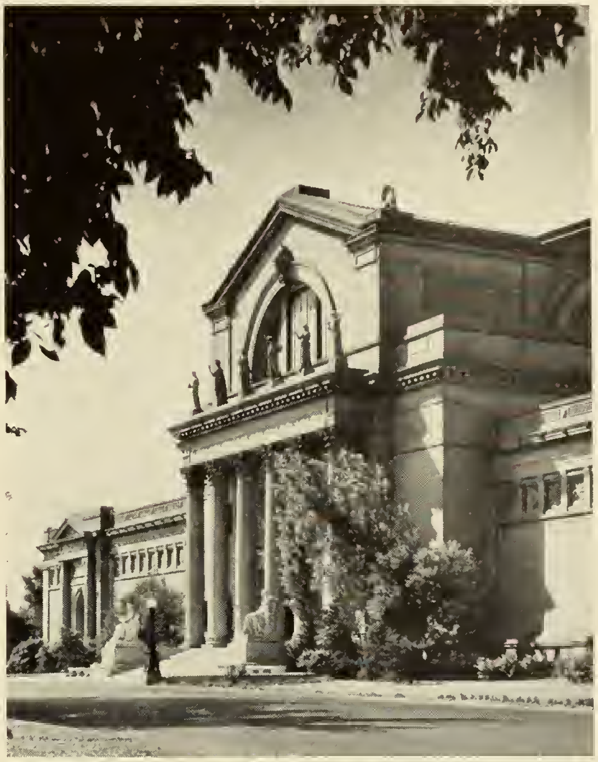
Another objection, applying with greatest force to Neo-Classical buildings, has to do with high cost of construction. It has been pointed out that columns, capitals, cornices, modillions, dentils, string courses, quoins, and the like belong to a past production which used much hand labor and hand carving, and that such parts made today are strictly reproductions of antiques and are therefore costly, to say nothing of their doubtful value. It seems important that savings up to or exceeding 25 percent can be made by elimination of an outdated kind of antiquarianism. To be sure, the sources of building funds are not always affected by considerations of economy. But there is unmistakable interest in cost on the part of building committees whenever preliminary sketches have to be reconciled with available resources.

Buildings designed in the older ways can be lived in somehow by museums, but they cannot be made to work very well—certainly not for the life of the structure.

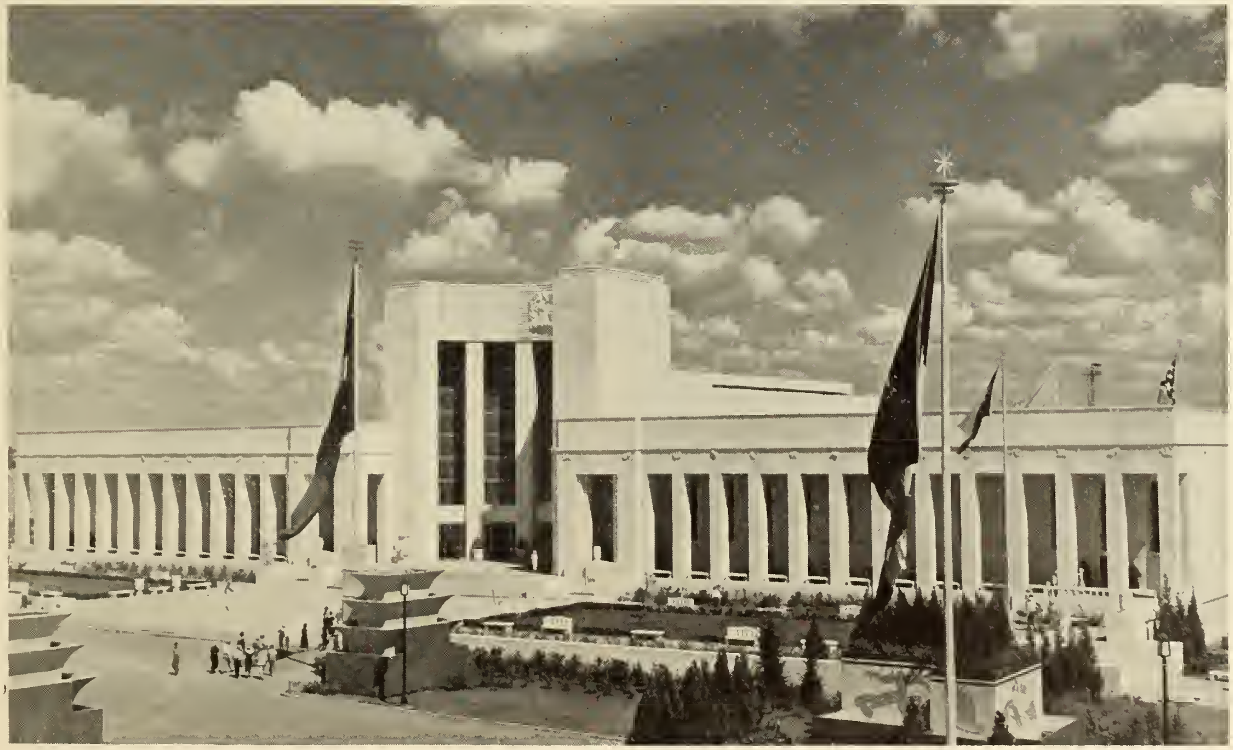
MONUMENTALITY, long under fire in discussions of style, has been the subject of more or less confusion that comes from defining it in several different ways. The term is taken sometimes to denote large scale, sometimes to refer to the use of a style for its symbolic standing, and sometimes only to mean resemblance to ancient buildings that have survived as monuments; perhaps the term has all these meanings together, or perhaps one and then another at the pleasure of the speaker. And further, the subject of commemoration often creeps in although it is quite distinct (page 26).

Scale—if that is what is meant by monumentality—can be judged apart from any style, ancient or modern. Large scale for museums has been either condemned as dwarfing the exhibit and the visitor, or defended as making for grandeur such as may seem necessary in a public building. Actually, museums as well as libraries have moved away from the grand scale toward the less ostentatious and more useful, so that for every new building of impressive proportions, there are many of modest architectural worth. Ceiling heights have been reduced. Spaces are now smaller. Masses of masonry have been replaced by lighter elements.

These changes have not made the architect any less responsible for embodiment of ideals; but rather there is now a social idealism that does not call for expressions such as were appropriate at certain times in the past and that seemed suitable for copying in our own day of great personal fortunes. It is wholly in step with the present time that museums are now typically housed in simpler and less pretentious structures than were formerly adopted. How closely the old symbolism was linked with outgrown habits of mind on the part of the architect's client, and perhaps of the architect himself, is brought out by some published remarks of many years ago. "At the entrance there is a real colonnade," wrote a museum planner, describing a certain project, "the idea being to impress upon the persons entering the building that they are going into a great monument, a place of importance, an institution worthy of consideration and thought." (*Proceedings*, American Association



(RIGHT) CITY ART MUSEUM, ST. LOUIS, MO. MONUMENTALITY OF 1904. CASS GILBERT, ARCHITECT
(BELOW) DALLAS HISTORICAL SOCIETY, TEX. MONUMENTALITY, 1938. WALTER C. SHARP, ARCHITECT



of Museums, Vol. 2, 1908, p. 80). The choice of Greek orders under some circumstances, of the Gothic under others, to stand for the better things has been a convention—understandable historically, but still a convention. For half a century, any staid and influential museum board, any well entrenched and therefore conservative donor, any government bureau with set practices, any architect trained in the old school, and almost any man on the street who accepts the world as he finds it, has been ready to carry on the accepted mores. It has taken years of creative work on the part of a younger generation, born in a world with new means that have literally commanded new ideas, to pull museums away from what has "always" been done. But the change has been made. The time has now passed when even the influences of surrounding older buildings can carry the day.

The professional side of the matter is revealed by some published notes on a recent architectural competition. An architect inquired: "Does the cubage include monumental entrance halls, corridors of classic proportions and grand stairways such as are essential for the proper dignity of a great government building?" Said the management of the competition in reply: "The cubage includes all elements of the building except those specifically excluded. *The intention of the competition is to select an architect skilled in practical and economical organization of space and structure rather than one experienced in the design of monuments.*" (*Bulletin V*, Smithsonian Gallery of Art Commission, April 12, 1939. Italics ours.)

Each period in human affairs has chosen its own architectural expression. The present accepts new forms, and for anyone to doubt their capacities is to miss the meaning of what has taken place. To think that the forms of ancient monuments can meet today's changed requirements or stand for today's changed ideas is monumental misapprehension.

CRITICISM OF THE NEW has given much of its attention to the general nature and aims of modern architecture. In the course of this discussion different aspects of the modern have been overstressed in turn; but there has come to be a broad understanding of the movement which practically dates it historically even now.

An early statement of the essentials of modern style which still seems to hold was made by Henry-Russell Hitchcock and Philip Johnson in their definitive work, *The International Style*, New York, W. W. Norton and Co., 1932. The year 1932, by the way, was on the eve of the style's adoption by museums. Three attributes are discerned by these authors: First, emphasis on volume, space enclosed by planes, rather than on mass and solidity; second, regularity through orderly structure made interesting, rather than balance as by axial symmetry; and third, dependence on proportions and the nature of materials rather than on applied ornament. Interpreting these conclusions, in its exhibition book, *Built in U. S. A. 1932–1944*, the Museum of Modern Art suggests a fourth attribute implicit in the others, namely, flexibility of plan.

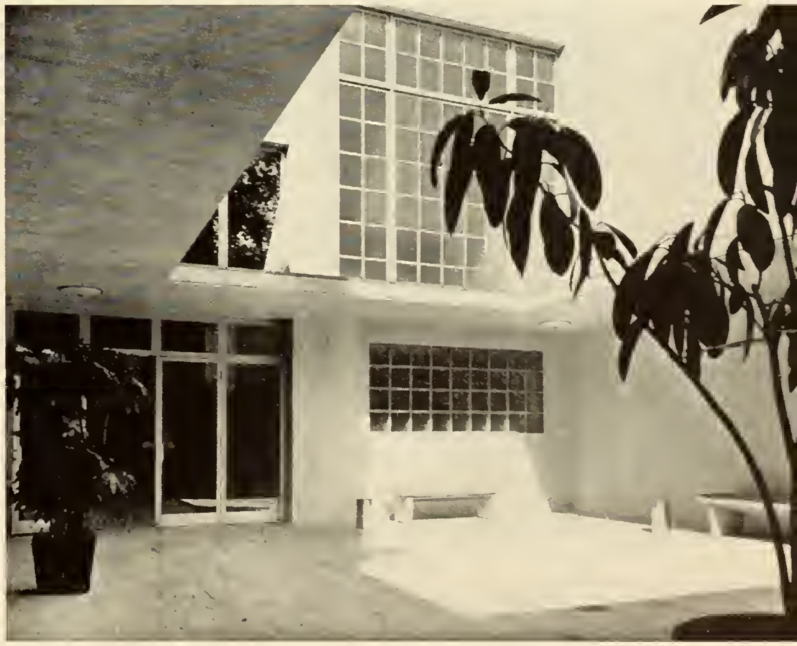
A recent symposium on "What is Happening to Modern Architecture," held at the Museum of Modern Art and published in the Museum's *Bulletin* for the Spring of 1948 reflects very well the present state of thought; and (true to the ways of art criticism) it reveals what is common ground by what is left unsaid in different special arguments. The focus of interest at the moment is upon warmth and feeling, the subjective side of designing, as contrasted to the coldly scientific side which has to do with functional and engineering considerations. The older heads point out that this is no "new humanism," but only part of the program as envisaged from the start. Another current question is on the relation of architecture as art to building as industry. But the speakers gave tacit acceptance to the definition of modern style as concerned with volume rather than mass, regularity rather than symmetry, and creative design rather than arbitrary ornamentation.

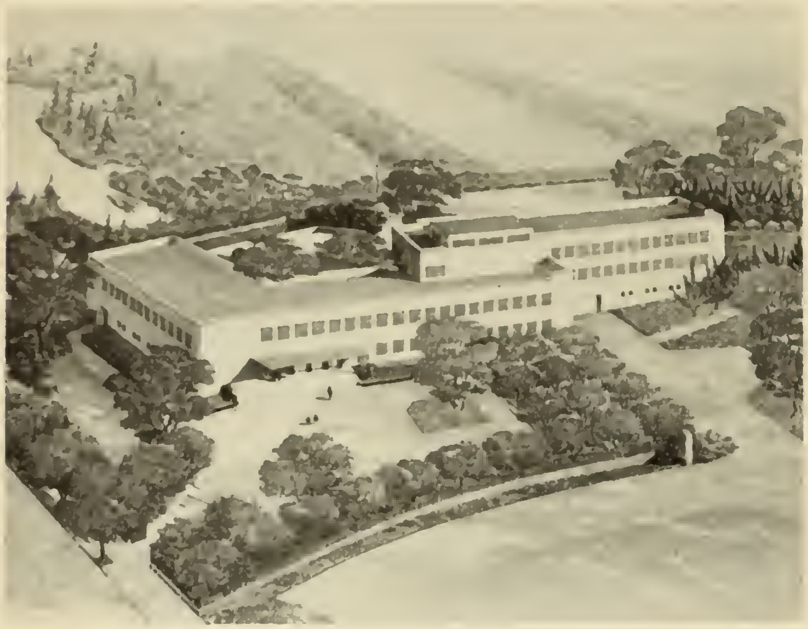
Reviewing museums of recent years in the light of these observations, one finds on the whole a transitional state of things. Most buildings show a mixture of old and new influences so that their scores on different points would vary considerably. And there are some modern-looking buildings that in fact are not modern at all because of their having symmetrically disposed bulks of masonry and applied decoration which is none the less false by reason of being modernistic.

As to the first modern criterion, that of space enclosure as contrasted to solidity and mass, it is interesting to note that in a museum of 1926, Hunt's Newark Museum, the planners made a very special point of staking out only general space claims for later free treatment at will. Architectural thought of that time could give no such solution as one expects today; nor, in fact, is architectural practice of today, except here and there, abreast of its own avowed aims. But anyone who doubts that this change in emphasis has been made should familiarize himself with current work of architectural schools, as exemplified in the *Bulletin* of the Beaux-Arts Institute of Design, New York City—comparing, let us say, the designs for *A Memorial Museum* in the *Bulletin* of April 1930 (a typical problem and solution of the past) with those for *A Museum for Visiting Exhibits* in the *Bulletin* of March 1942 (an up to date problem with a contemporary solution). The near future will have no more architects trained in the old tradition. Thus, by a worldly sad fact, to say nothing of the principle of the thing, the erstwhile preoccupation with solids has practically given place to preoccupation with voids.

As to flexibility, which is implicit in other points of the modern program and especially in emphasis on space, there is a mixed situation among museums. Division of exhibition space by regular lines of the exhibits themselves is not absent from older buildings; but positive flexibility, provided by movable partitions in spaces designed to be completely rearranged at will, is distinctly new. This is carried out most freely in the Museum of Modern Art, where extensive changes of floor plan may be the order of the day when each new show is installed. Similarly, there are science museums made deliberately fluid, as at Rochester and Grand Rapids, although the nature of science exhibits tends to retard

PORTLAND ART MUSEUM, ORE. PIETRO BELLUSCHI, ARCHITECT





PROJECTED BROOKLYN CHILDREN'S MUSEUM, N. Y. BROWN, LAWFORD AND FORBES, ARCHITECTS

the process of further change after installations have once freely employed the flexibility left behind by the architect. In any case, bulky dividing walls that do not lend themselves to flexibility as now understood, are not favored, even though these walls may be nonbearing and therefore capable (at a price) of being knocked out and relocated.

The desire for flexibility gives some pause to those who see in it many a possibility for violation of the designer's intentions by occupants of the building who may not be sensitive to design. This danger is real, and it throws upon museum people themselves the responsibility of being equal to redesigning, not just rearranging, their displays.

The second main point of the modern program, which has to do with regularity through orderly structure as opposed to balance by axial symmetry, is not seen in all new museums. A few advanced buildings, among them the art museums of Colorado Springs and Des Moines, are notable works of dynamic composition, shaped and articulated by promptings of function, construction, and terrain; but there are also some recent buildings of "scraped Classical" character, traditional in composition though lacking orders and traditional ornament. How difficult it has been during the transition period to take full practical advantage of gains in principle can be seen from the following description of Hartford's Avery Memorial, published when the building was opened: "The exterior, it is true, is designed according to the stipulation of the donor to harmonize with the existing Morgan Memorial. It is not, therefore, strictly modern in design, although in clothing a modern interior the façades are necessarily not particularly traditional either. . . . In the interior *only the symmetrical disposition of the main axes* . . . continues the scheme of the traditional museum design. The court, the galleries and the theatre are examples of consistent modern treatment. . . . " (*Bulletin*, Wadsworth Atheneum, January–March, 1934. Italics ours)

The present possibility of composing a vertical with a horizontal mass or of joining a number of otherwise unlike parts into a unified whole, without having to produce an application of bilateral symmetry, is a powerful gain for both workable arrangement and workable enlargement of the building. Without such freedom, under the Classical influence, space had to be organized primarily by rule; but under the modern program enclosures of space can be disposed realistically and new parts can be projected where they promise to be required. It is true that good designing never has followed and never will follow all the promptings of practical use, nor in fact can it follow any of them blindly; even Louis Sullivan who stood sponsor for the idea that form follows function "did not eat his functionalism as hot as he cooked it." But now that form is free to be guided by requirements of use together with broad considerations of design, rather than by balanced layout, a very great deal has been gained. To say, as some do, that the modern is anti-symmetrical is true in the sense that it is against arbitrary restraint of all kinds, but this is no more than freedom to be useful and creative. It is only one or another very limited phase of the modern that can be fairly characterized as "neo-romanticism expressed in terms of modern dynamics and technology." (M. F. Kirchman, *Logic? . . . or Aesthetics?*, *Progressive Architecture*, August, 1947.)

The third essential character of modern style, having to do with reliance upon line and mass and attributes of building materials rather than upon applied arbitrary ornament for aesthetic qualities of design, is a side of the new which some museums have quite fully embraced, as shown for example by Meem's building at Colorado Springs and Saarinen's at Cranbrook—the former employing the decorative texture of monolithic concrete relieved by a cast-in line and enlivened by aluminum trim, and the latter employing the warmth of a common brick in contrast to limestone trim with the simplest of inscribed accents. While interest in new means is leading designers to explore the capacities of concrete, metals, glass, ceramics, and plastics as well as of older materials, it must not be forgotten that ferro-concrete itself is a new material in spite of its familiarity now, and that no excursion into untried substances is necessary to make it true that modern architecture goes along with materials which were not available to the architect in earlier times.

We have noted above a tendency of the moment to put designers into one or the other of two extreme positions—as wanting either decorative over-warmth or only stark construction. However, one can hardly question that well balanced designing will take account of both engineering and aesthetic considerations, just as it takes account of both rational and creative aims. There is nothing contradictory, in the Colorado Springs building, between John Gaw Meem's forthright structure on the one hand and, on the other, Boardman Robinson's frescoes above the main entrance and Frank Mechau's frescoes in the patio. Nor is there any contradiction between Eliel Saarinen's structures at Cranbrook and the presence on the landscaped terrain of Carl Milles' sculpture, which was produced in close collaboration of purpose with the architect. Modern style rejects dictates of arbitrary applied decoration, but it can accept contributions of the graphic and plastic arts, whether applied or intrinsic, provided they are consistent with its program of meeting practical and aesthetic ends by appropriate present-day means.

PATIO AT COLORADO SPRINGS, COLO. ARCHITECT, JOHN GAW MEEM. FRESCOES BY FRANK MECHAU

One sometimes hears it said soberly that modern buildings will be dated in time. This

is true, of course; everything is dated in time, and some phases of modern style are dated already. No day has been able to design for long into the future, and least of all can this be done at any time by holding to an already out-lived past. Modern style is young, but it is not an experiment. It has sound work behind it in all sectors of architecture. It is not another style, added to several from which one may reasonably choose. Modern style is the only style of the era in which we live.

LOGGIA AT CRANBROOK ACADEMY, MICH. ARCHITECT, ELIEL SAARINEN. SCULPTURE BY CARL MILLES.

CHAPTER VII. LIGHTING

Museum lighting, in its different applications, is much the same as lighting in buildings of other kinds—except for the lighting of exhibition space. To the illuminating engineer, a museum lecture hall is like any other lecture hall; a museum library, with its reading room and stacks, is like a comparable unit anywhere; and similarly museum offices, shops, classrooms, and other work spaces call for common lighting arrangements appropriate to their familiar uses. But museum exhibition space sets problems that collectively are unique. The emphasis, not to say the exclusive attention, placed on this branch in writings about museums is betrayed by the currency of loose terms such as "windowless museum" and "skylighted museum" which, by their very inexactness, show where the difficult and also most interesting part of the matter lies.

EXHIBITION LIGHTING is practiced very unevenly by museums. Old buildings are bogged down in old equipment that ordinarily cannot be redeemed through alterations. Remodeled buildings show most incongruous mixtures of old and new, the best parts corrupted as a rule by keeping company with the worst. And even new buildings are not free of commitments to yesterday, although among them are many suggestive and some good examples of exhibition lighting.

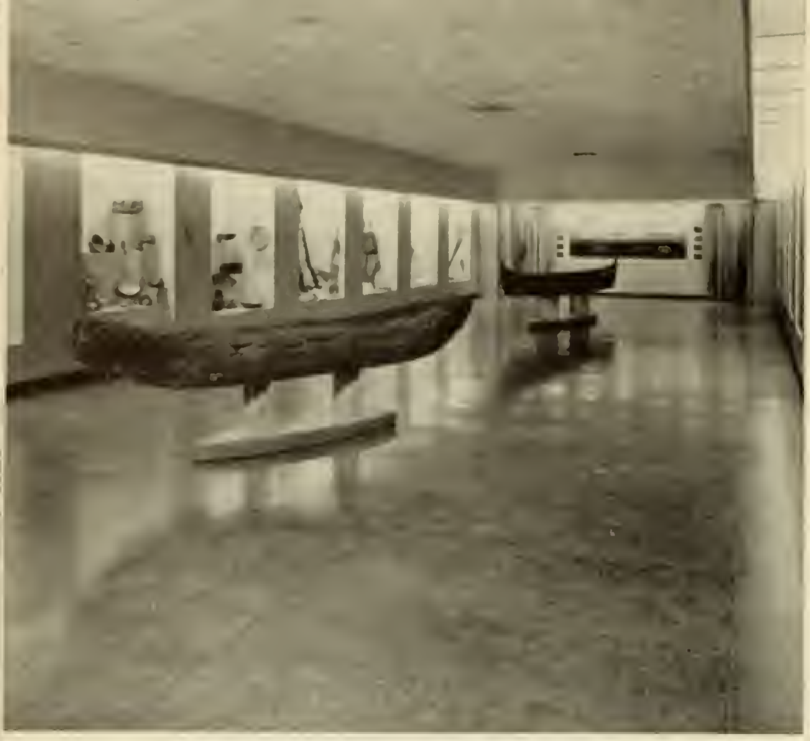
For a review of methods more or less long in use, together with an excellent critical discussion, one can turn to an account by Clarence S. Stein which forms Chapter III, *Eclairage naturel et éclairage artificiel*, of the book *Muséographie* published by the International Museums Office, Paris, in 1934.

Museum designers seem on the whole to be victims of the sort of progressiveness that tries to advance by modernizing things of the past rather than by pushing aside the old and making a wholly new start. In fact, even the approach has usually been wrong, because museum planners customarily visit museums here and abroad to see what they show of how things used to be done. In the future it would be better if observers would spend time making general observations in our leading cities, taking note of latest stores, office buildings, factories, railroad stations, theatres, restaurants, and even homes. Museums might then find some of their proverbially troublesome problems giving way to new solutions in the swiftly moving field of illumination.

Objection to considering such examples may be expected from anyone who jumps to the conclusion that natural lighting would thus be ruled out of court and that artificial lighting would completely win the day. However, this does not follow at all. Actually most of our daytime indoor life in the modern world is carried on not by artificial light alone but by daylight and artificial light together. No sensible student of lighting can ignore either natural or artificial means.

MIXED LIGHT—that is, light coming partly from the sun and partly from lamps—is what we are accustomed to during daylight hours. The natural ingredient does its share of the lighting, and in addition it sets some of our primitive feelings at rest; the artificial ingredient makes up for the fact that natural light is not able to do a fully satisfactory job indoors. Museums as well as buildings of most other kinds show recognition of the double requirement. Let anyone who doubts this look around, noting in museums that exhibition rooms, including the kind with the largest supply of daylight, namely, skylighted galleries, ordinarily have some of their overhead lamps turned on during even the bright hours of clear days.

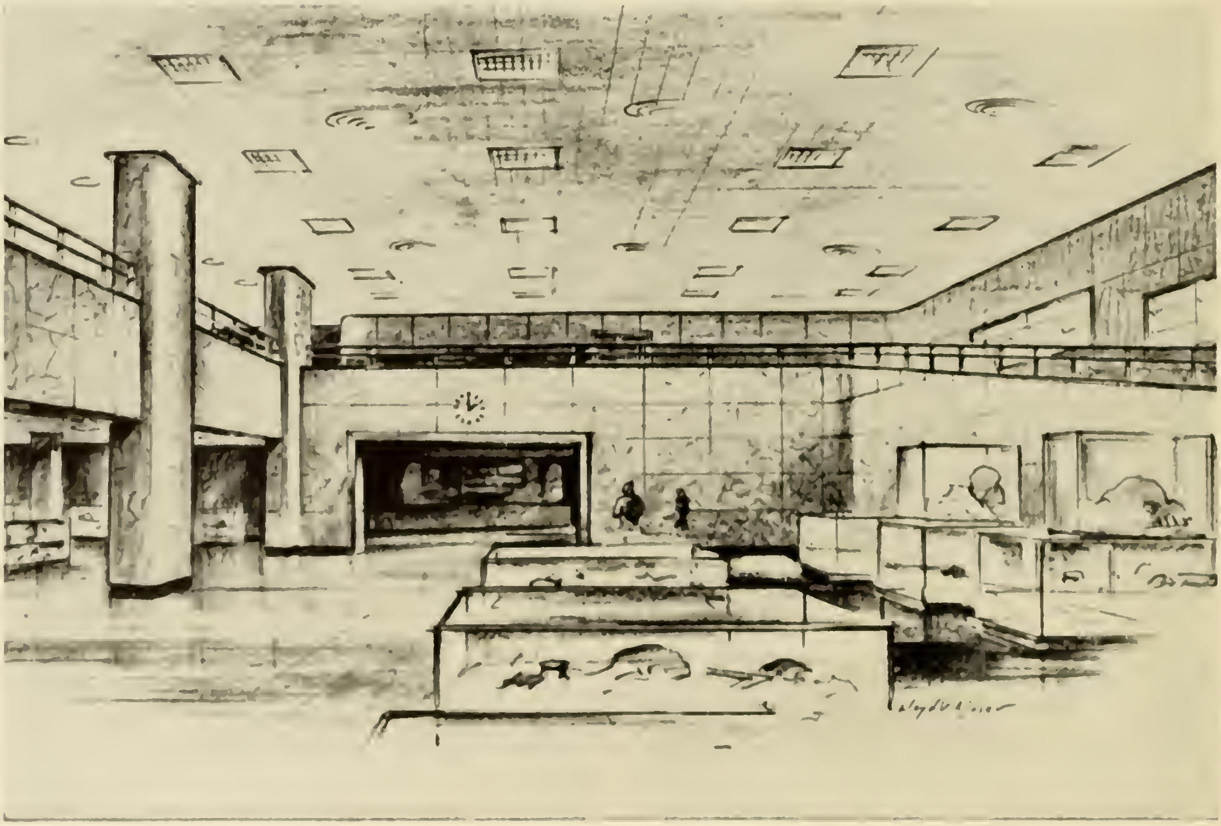
However, science museums have now come to the point of wanting only artificial light in their exhibition spaces. Natural means are unsuited to the varied requirements of didactic display and of case installation; and the character of science materials minimizes certain subtle problems of seeing, that come first with art museums. It is not sur-

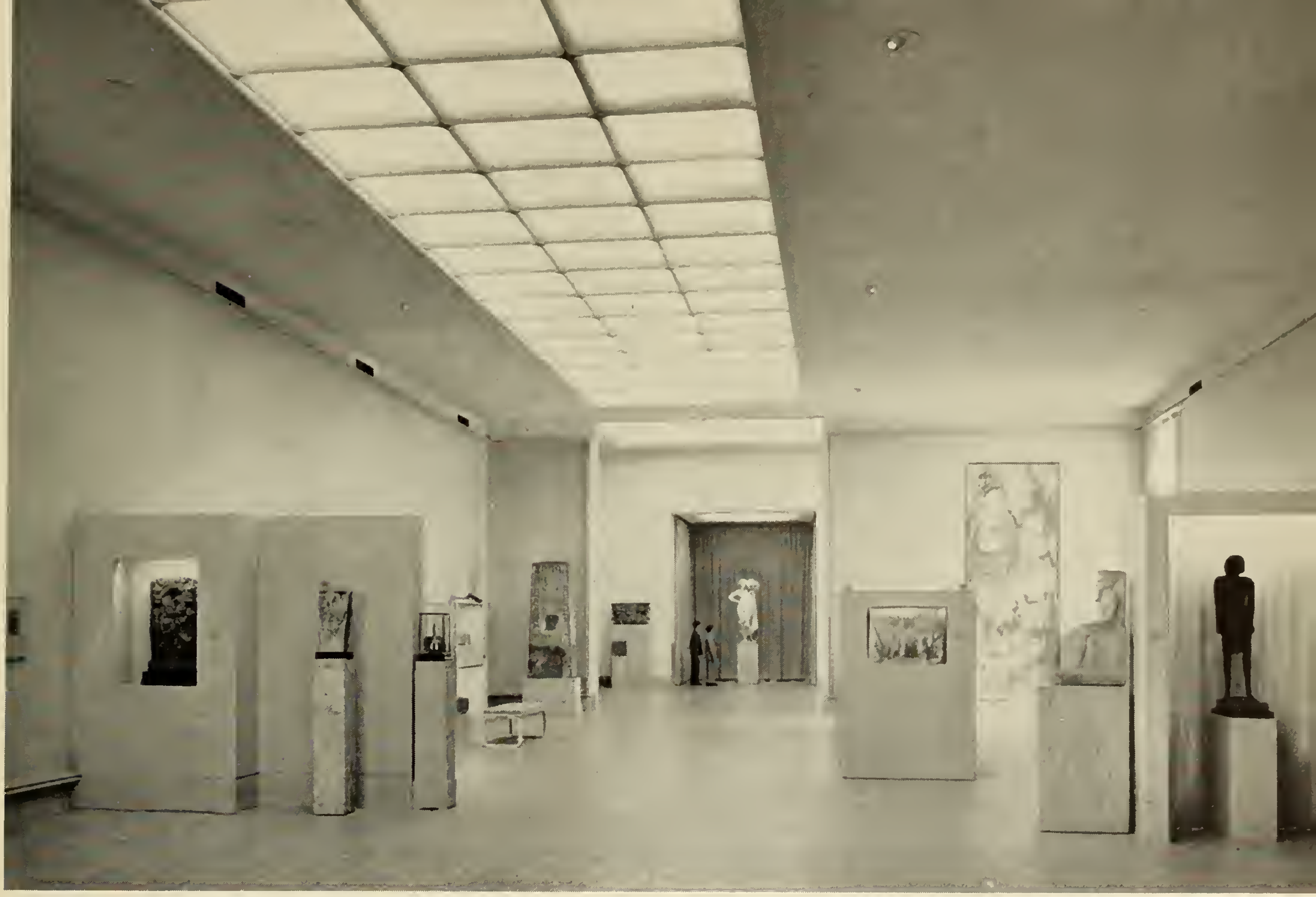


Courtesy Cranbrook Institute of Science

RECENT (ABOVE) AND PROJECTED (BELOW) SCIENCE EXHIBITS EMPLOY ARTIFICIAL FLUX FOR THE ROOM AND ARTIFICIAL LOCAL FLOODS AND SPOTS FOR THE EXHIBITS. NATURAL LIGHT IS EXCLUDED, EVEN FROM USE IN MINOR ROLE FOR ROOM LIGHTING

Courtesy Indiana State Museum





Courtesy Cranbrook Academy of Art

MIXTURE OF ARTIFICIAL FLUX FROM INDIRECT PANELS ABOVE AND NATURAL TOKEN FROM CORNER WINDOW FOR COOL ROOM LIGHTING. ARTIFICIAL SPOTS FOR OBJECTS

prising, therefore, that projected science museums block out all daylight from exhibition space. This does not remove spaces that are so treated from application of the principles set forth below, although it does deny to them the humanly most important aid of natural light in its minor role in room lighting—a role we shall see best recognized in the treatment of art museums that have galleries with what may be called token natural lighting.

Among the art people—having problems that are not essentially distinct, even if they may be special in certain respects—there are holders of strong opinion on all sides of museum lighting questions. "Supporters of window lighting, artificial lighting, and skylight illumination are about equal in number and authority," writes an architect. Literally, anyone who is interested seems to be expected to take one side or another; and a person need only mention some disadvantage of, say, the exclusive use of daylight to be ticketed forthwith as "against" natural lighting (which no sensible person should object to, any more than to mother's milk) and hence as being "for" artificial lighting (which everyone should favor to the extent of its usefulness). There can be only limited progress in this department of museum practice while responsible people continue thus to align themselves for or against everything except the best use of all means at hand.

Neglect of one or another side of the lighting problem has led to an especially unreal opposition between objective, or engineering, views on the one hand and subjective, aesthetic, views on the other. This shows up well in the following two statements—the first by a group of lighting engineers: "Galleries of the future," says the Committee on Art Gallery Lighting of the Illuminating Engineering Society, "are likely to be lighted entirely by artificial light, as it is doubtful if an art gallery can be designed to give satisfactory natural lighting during much of the year. Such natural lighting had to be accepted in the closing quarter of the last century, when most of the world's art galleries were built, as no satisfactory artificial substitute was available. Today, any interior gallery can be artificially lighted to better effect than is possible by daylight; and, in addition, it can always reveal each item in its best aspect, which is only a fleeting occurrence under natural lighting." (*Illuminating Engineering*, Jan., 1945, page 13.) From the opposite position comes an art connoisseur's statement: "Artificial light, even if perfected to the highest degree, has never the strength of sunlight and is more fatiguing to the eyes, as it does not stimulate the retina by a constant change of the intensity and color of the light rays, as does daylight. Every sensitive person will rejoice to see sunlight again when he comes out of an artificially lighted museum into the day." (Valentiner in *New Architecture and City Planning*, Philosophical Library, 1944, page 660.) Doubtless most art museum people would agree with the latter view, whereas most science museum people would agree with the former. Both sides are partly wrong—the science bloc not paying much attention to what the art writer says about "rejoicing," and the art bloc not being content with what the engineers call "better effect." Each side could have the value of the other's wisdom, and at the same time could come a great deal nearer to suiting the public, if each would freely accept the *two* kinds of lighting used together. This is for daytime. By night even sensitive people accept the sun's departure.

Human factors other than visual perception enter into judgments of lighting and of the relative merits of natural and artificial light. There is, for instance, the trace of claustrophobia that most of us feel in the absence of windows or other openings through which to look out. Also, there is the reassurance that comes of having even a little natural light, even without any view, not to mention the reassurance that clings at night to the mere presence of a window though it can give neither view nor light. Such feelings should be understood as distinct from experiences of color perception, visual acuity, ocular fatigue, and kindred matters of seeing which are capable of measurement in the laboratory.

The preference for "living," in the sense of changeable, natural light as opposed to "dead" artificial light seems to be held by curators who like to see their exhibition pieces in different character at different times. This, whatever its rewards for the staff, makes the public see things in one poor light or another most of the time. But luckily it should be possible with mixed light by day to satisfy the principal needs of both seeing and feeling, and with *good* artificial light by night to do pretty well after all. The museum designer's task is to get the values of both natural and artificial light without too many of the disadvantages of either.

Despite a quantity of folklore as to the evils of mixing lights, there is no objection whatever to blending the natural and the artificial. Both, to the eye, are just light; and what counts is the nature of it, regardless of the source. Sometimes even observers who understand this are unappreciative of mixed light—the reason being that they find the sun's help erratic, not that they object to the mixing process. The trouble here seems to be that "the natural partner in the combination varies widely in chromaticity and quantity, from day to day, and season to season, and frequently will change in both color and quantity in the matter of minutes." (*Illuminating Engineering*, Jan., 1945, page 20.)

COLOR OF LIGHT, from whatever source, is a large factor in both concerns of lighting—the matter of what one sees, and the matter of how one feels. Much of the difficulty in any judgment of color, as in most other judgments of lighting, comes from the confused area of what we feel we see. Lifelong, regular habits strongly condition our responses, as shown for instance by our acceptance of yellowish light more readily at night than in the daytime.

Natural light has a wide range of mixtures of the primary colors. At one extreme of the spectrum is the so-called "cold" blueish light from the sky, and at the other extreme is the "warm" yellowish or reddish light coming more directly from the sun. Opinion has changed as to what kind of light is best for lighting exhibits. Cold, or north, light was preferred in the last century, perhaps because at that time direct sunlight was very difficult to manage in a museum. However, even before the day of a diffusing glass that could break up sunbeams the tide of opinion had turned, and warm light is now distinctly favored. North light, as Stein points out, has been discredited in at least three early investigations: by the Royal Commission of the Netherlands (1902) in efforts to determine the best lighting for Rembrandt's Night Watch; by the Museum of Fine Arts in Boston (1903) on the basis of studies for its new building; and by the British Department of Scientific and Industrial Research, after trials with an experimental gallery reported in *Technical Paper* No. 6 (1927).

However, if museum exhibits are made visible in one acceptable way by artificial means, there can surely be no good objection to letting the aesthetically inclined visitors have the unction, however unreliable, of some natural light in addition.

The different color mixtures of natural light, each one a nameless blend of spectral colors from the sun, can be compared to the successive color mixtures given off by a piece of iron as it is heated from just visible red heat through yellow and white to blue-white heat; and, since the temperatures of the iron can easily be measured, its corresponding colors can be designated conveniently in degrees. For this purpose a scale of Centigrade degrees with zero at minus 273° C, known as the Kelvin (K) scale, has been adopted; and its readings are known as color-temperatures.

Color-temperatures of natural light range widely over the scale. The setting sun gives light of around 1000° K, that may be said to look "red hot." The rising sun gives light at a little less than 2000° K, that may be called "yellow hot." Direct sunlight during most of the day corresponds to about 5000° K; and mixed light, or the average light of day when the sun is behind a cloud, is of about 6500° K, which is "white hot" light in the sense that, like any white light, it contains a mixture of all colors from the red to the blue end of the spectrum. North sky, or overhead sky when the sun is not too close by, gives light of about 12,000° K, which we might call "blue hot" were it not for an inconsistency of language by which we speak of blue as "cold." Thus one may use Kelvin degrees, associating sunlight with 5000 or less, average daylight with about 6500, and light from north sky with 12,000 or more; or one may employ the vernacular and speak of warm sunlight, mixed daylight, and cold light of the sky. In either case these designations have nothing to do with intensity of light, although to be sure the sun is brighter than the sky and average daylight is brighter on a clear than on an overcast day. Setting aside the matter of intensity and brightness, and considering only color for the moment, one comes upon some applications of color-temperature data in exhibition lighting by artificial light and by mixed light.

Artificial light is produced by lamps and filters in a great variety of colors, but the colors most useful to museums are those of blended character approximating color mixtures of natural light and therefore capable of being designated by degrees of color-temperature. In this sense the light of a candle flame is at about 1600° K. Incandescent tungsten-filament lamps of latest design give light at 2400° to 2800° K from the regular vacuum type, and at 2800° to 3100° K from the daylight gas-filled type. Fluorescent vapor lamps include the regular type at 3500° K and the daylight type at 6500° K, with a compromise in a new type at 4500° K.

The spectral composition of light from a 6500° fluorescent lamp differs slightly from the composition of average natural daylight having the closest color-temperature. The lamp, like all fluorescent lamps, is somewhat deficient in the deep red part of the spectrum; but there are only very small differences in the appearance of colored objects when compared under this light and equivalent natural daylight. Moreover, what is lacking in deep reds can be made up by other means, as we shall see presently. The light of the daylight fluorescent lamp is much nearer to natural daylight than the light of any unfiltered incandescent-filament lamp. Fluorescent lamps have high luminous efficiency, several times that of an incandescent lamp, and their color is being steadily improved through research.

Artificial light of a higher color-temperature than average daylight can be produced with daylight incandescent lamps aided by corrective filters. There is a convenient form of lamp and filter combined, known as the blue-bulb incandescent lamp, or blue lamp; but since its use involves the cost of changing the filter each time the bulb burns out, the use of a separate "north skylight" filter is more common. Filtering of any kind reduces luminous efficiency, but this difficulty can be minimized by filtering only a part of the light. Thus, art museums at Kansas City and Pittsburgh report the use of one blue lamp with every one or two daylight lamps. One blue lamp and two daylight lamps give a light mixture resembling that of north sky; and equal numbers of blue and daylight lamps give a mixture approaching the light of zenith sky. However, present practice favors the alternative of using 4500° or 6500° *fluorescent* lamps for the purpose of giving a cool flux of light such as might enter a room through clerestory windows. If desired, the apparent color-temperature of 6500° lamps can be raised to a still higher value by adding a small proportion of light from *blue* fluorescent lamps.

The evenness, or uniformity, of a flux of artificial light not from minute to minute but from point to point—is common kind of "deadness" that is partly a matter of color. Under ordinary conditions of natural lighting there is an assortment of different kinds of daylight. White light is likely to enter a room more or less directly from the sky; light colored by reflection, perhaps from pigmented wall of nearby buildings, comes in at various angles bringing its different contributions; warm sunbeams may strike the floor or walls; and the furnishings of the room add their own patchwork of glows. All these contributions do not necessarily make the natural lighting good; but they make it what we have learned to expect. Such conditions are far from what one usually finds in a room that is flooded with artificial light. No matter how near a uniform light flux may come to being of one or another daylight quality, it is unsatisfactory because it is not varied. The plain need is for artificially produced modulation.

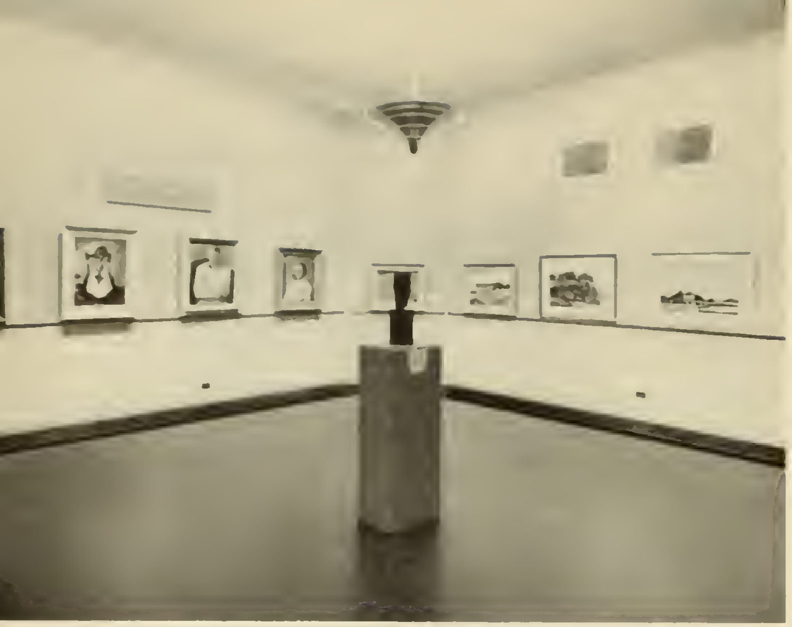
Some museums are solving this problem by use of light adjusted in color, and perhaps in intensity also, to individual displays. Thus one wall may have several lightings, or adjacent or opposite walls may be differently treated. It has been suggested that three spot lights of the primary colors be used, in adjustment as required, for showing to the best advantage any object of especial importance. The Museum of Fine Arts, Boston, has been making experiments in its gallery for recent accessions and has devised an overhead lighting installation that can be adjusted, as a whole and in each unit, for both color and intensity.

Experience shows that a simple way of meeting a large part of the need for variety is by having two kinds of lighting. The room may be lighted indirectly by say 4500° fluorescent lamps, thus approximating conditions in a room with a flux of mixed daylight; and objects on display may be lighted directly by unfiltered incandescent lamps (2800° to 3100° according to wattage) giving either strictly localized floods or spots on individual objects, like beams of sunlight touching here and there. With natural lighting the color-temperature differential would be between cool light of the sky at perhaps 13,000° and warmer sunlight at perhaps 5000°; but the eye readily accepts a smaller differential at lower points in the color-temperature scale, as between the suggested 4500° and the 2800° to 3100° contributions of artificial light. For further variety in some rooms the color-temperatures of nature could be more nearly approached through the use of 6500° fluorescent lamps for general lighting, and of 4500° fluorescent lamps for cases and objects. Neither of these lights alone might make for peace of mind, but the cool and warm lights in good combination are satisfying. Incidentally, one can discover how large a part habit plays in human acceptance of conditions by reversing the lights, using warm general lighting with cool local spots, and feeling the eye's prompt cavil.

These considerations do not rule out, nor are they necessarily affected by, the presence of natural light. They have to do with the acceptability of artificial light when it is used with skill. As to why there need be any artificial lighting, however skillful, one must turn to matters of light intensity. To simplify this subject in its museum application one should first note something that is doubtless already apparent, namely, that exhibition lighting is not at bottom one problem, but two—lighting of rooms, and lighting of objects on display.

ROOM LIGHTING AND OBJECT LIGHTING

ROOM LIGHTING AND OBJECT LIGHTING are different in their purposes, and largely distinct in their means. The purpose of room lighting, aside from keeping visitors from falling over benches, is to make people feel at ease and to provide conditions under which object lighting can be carried out successfully. The purpose of object lighting is to have objects seen clearly and in their full character. The matter of human ease commits natural light to a part in room lighting—at times of day when nature offers opportunity for this. The matter of seeing things clearly and in character commits artificial light to the major part in object lighting at all times, if only for the reason that there exists no other way of adjusting intensities in all parts of a room to require-



ALL-PURPOSE LIGHTING, BY ARTIFICIAL OR NATURAL MEANS, MISSES SEPARATE PROBLEMS OF ROOM AND OBJECT LIGHTING

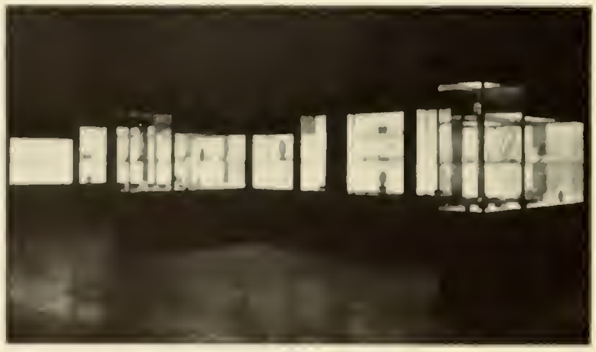
ments of the eye, and of giving highlights and shadows to bring out texture and three-dimensional form. As a rule each kind of lighting helps somewhat toward the purposes of the other kind, but this does not affect the essential difference between them.

The very important distinction between the needs of the room and of the object has been overlooked in much of museum lighting, although it is fully familiar in other departments of life wherever close seeing is required. In libraries it is observed for reading. In offices it is taken as a matter of course. In factories it is demanded by considerations of safety as well as of efficiency. But in museums the right arrangements, where they are found, seem to be results of improvisation more than of forethought. All-purpose lighting is what museums often try for, whether by natural or artificial means or both. Quite familiar, even in new buildings, are examples of case lighting where the room gets on as best it can by spill light alone. The difficulty has been characteristic of the older museums, especially of those with natural lighting only. Efforts have been made to secure the required different intensities of natural light for room and objects by means of special light openings and of baffles and mirrors; but no such scheme is satisfactory.

Further, there is no solution through providing merely an abundance of light. It is *relative* brightness of room and object that counts; each exhibition space must be dealt with as a whole in order to achieve results that neither general nor local lighting can get alone. This brings us to matters of relative brightness; and, looking into that side of things, we shall come again to the conclusion that artificial light must play the leading part, though it need not play all parts, in lighting rooms and exhibits by day. If this seems to give lamps too large a role for art and too small a role for science museums, the discrepancy itself should be suggestive.

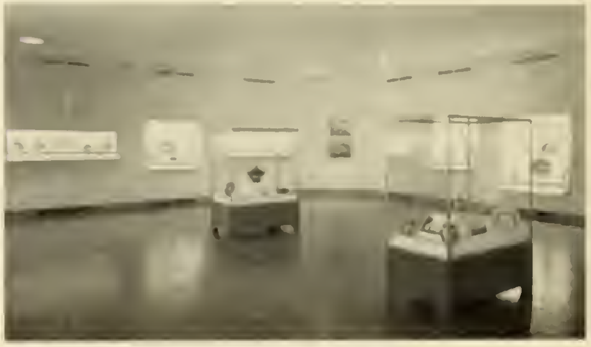
OBJECT LIGHTING WITHOUT ROOM LIGHTING GIVES EXCESSIVE BRIGHTNESS CONTRAST AND BAD SEEING

Courtesy Metropolitan Museum of Art, New York



REQUIRED ROOM LIGHTING PRODUCES CONDITIONS UNDER WHICH GOOD OBJECT LIGHTING IS POSSIBLE

Courtesy Worcester Art Museum



ILLUMINATION AND BRIGHTNESS, produced by light falling upon surfaces and light reflected from them, must both be considered in museums. Much attention has been given to illumination; but too little is given to brightness, without which illumination would be futile.

Intensities of illumination and brightness are stated in units called footcandles and footlamberts, respectively. All light sources, natural and artificial, generate light quantities of which the units are lumens. Lumens per square foot falling upon a surface give footcandles, which state the intensity of light supply, and are predictable by the use of standard design data. Footcandles are independent of the character of the surface illuminated; but the character of the surface does determine how much of the light received is absorbed and how much is returned for the eye. Lumens per square foot coming off any surface that is not mirror-like give footlamberts, which state the intensity of brightness of the surface. An authoritative nontechnical review of this and related subjects is to be found in a book by Matthew Luckiesh, *Light Vision and Seeing* (Van Nostrand, 1944).

Measurements in footcandles and footlamberts may be made by means of a light-meter, a standard instrument enclosed in a little box with a window that can be faced toward a light source for readings in footcandles or toward an illuminated surface for readings in footlamberts. If, as in most rooms, the light comes at different angles from several sources, footcandle readings are best taken with the meter directed either horizontally or vertically—as on top of a table case with the window of the meter facing upward, or against a wall or the front of a wall case with the window facing outward. Readings so made are said to be, respectively, in footcandles on a horizontal surface (*not* "horizontal footcandles" which is an equivocal term) or footcandles on a vertical surface (*not* "vertical footcandles"). To measure footlamberts of reflected light, the meter is held with its window facing the reflecting surface at a point 2 to 4 inches from the surface since at this distance the scale reading is fairly constant. The reading multiplied by 1.25 gives the approximate brightness in footlamberts—the factor of 1.25 being a lump correction for the effect of the many angles at which light enters the meter from a diffusely reflecting surface. The light-meter and its uses are described by C. L. Dows and C. J. Allen in *Transactions of the Illuminating Engineering Society*, Vol. 31, No. 7, July, 1936.

The relation between illumination and resulting brightness depends upon the character of the surface lighted, this being expressable by a so-called reflection factor, and upon whether the surface reflects diffusely like blotting paper or sharply like a mirror. Specular, or mirror, reflections are likely to interfere with seeing because they do not break up glares. We see best by diffuse reflection, which is the kind of reflection that makes an illuminated area look equally bright from all angles. Diffuse reflection factors can be determined roughly by dividing reflected footlamberts (meter reading × 1.25) by incident footcandles. For a factor of 100 percent, the two intensities would have to be equal. Many white objects, such as white labels, show factors around 80 percent, but the ordinary run of things that can be seen easily under moderate illumination have factors between 25 and 35 percent. Materials with factors in this range are good for case backgrounds and wall coverings. Factors below one or two percent mean very dark surfaces, and objects with such small factors may be difficult to see except in silhouette.

Contrasts in brightness are as important to seeing as is the level of brightness involved.

Too much contrast is bad because the brighter surface, by forcing the pupil of the eye to contract, makes the less bright surface hard to see. This applies to objects and their backgrounds, and also to different objects or areas close together, or to parts of a room that lie within a field of vision, to say nothing of high contrasts between sources of illumination and the brightness of things they light.

The best brightness contrast is in the neighborhood of 2 to 1—the object twice as bright as its background. And where case backgrounds and wall surfaces have diffuse reflection factors of from 25 to 35 percent, contrasts of 2 to 1 are likely to result since many exhibited objects have factors near to this range. Contrasts up to 5 to 1 are good, and up to 10 to 1 allowable; but greater contrasts make seeing difficult. Areas of highly contrasting brightness on walls, floor, or ceiling or in adjacent rooms can ride herd over the most carefully adjusted brightness contrasts between exhibits and their backgrounds. And glares of illumination can practically blind the observer, as where an object is viewed in the direction of a window, with a contrast of the order of 500 to 1.

Intensity of illumination cannot be prescribed without regard to consequent brightness and brightness contrast. There may be good seeing conditions under either high or low intensity of light; and therefore it makes no sense to advocate one or another lighting plan merely on the ground that it develops light in great abundance. To advocate high intensity of supply is usually to betray oversights in some other respects (for example, disregard of the need for separate object lighting). If diffuse reflection factors are in the 25 to 35 percent range, and resulting brightnesses do not contrast among themselves more than 10 to 1 or come into competition with glares that contrast more than this, there can be good visibility with from 10 to 50 footcandles of incident light. This is not a high allowance, though it represents more than has been usual in the past. A century ago people read by one footcandle, but now we expect at least five footcandles and we like from 20 to 50, with an optimum of about 25 for most purposes. At 25 footcandles and with ordinary reflection factors, brightnesses would be from 6 to 8 footlamberts on the average, and variant factors could produce from say 3 to 30 footlamberts without exceeding the allowable 10 to 1 range of contrast.

These principles apply to both room and object lighting. *For rooms* in which other conditions are average it seems to be agreed that 10 footcandles are enough, while 5 footcandles or even less may suffice. *For objects*, whether on walls or in cases or standing free on the floor—requirements vary with the character of the materials displayed. Published reports on museum lighting and some unpublished observations indicate that from 15 to 50 footcandles are usual, and that the commonest requirement is between, say, 20 and 30 footcandles; this is for rooms with perhaps 10 footcandles of general illumination. Objects of light shade as well as black-and-white objects such as most prints and labels need only 15 to 20 footcandles to be brought out well. Darker objects such as many paintings and the general run of decorative art, natural history, and culture history objects need 25 or 30 footcandles, sometimes more. White sculpture and plaster casts may require even less light than white labels since subtleties of shadow disappear in the presence of too much brightness; but bronze casts, like most objects of dark metal or wood, may require up to several hundred footcandles of accurately placed artificial light.

An almost constant fault in museum lighting of the past has been reversal of the right relationship between room and object brightness, due to the absence of separate object lighting. The most commonly noted example has been that of the skylighted room with from 500 to 1,000 footcandles on the floor and less than 100 footcandles on the best lighted wall. It is little wonder that the mistake of selecting dark material for flooring has gained a hold. Many rooms with side lighting show contrasts of 100 to 1 on walls, not to mention blinding contrasts between windows and wall spaces around them. The principal reason for this whole difficulty is that lighting has been treated as one problem, rather than as two. Light has been admitted or produced in a flood that could more than take care of the room but that gave exhibits little chance of being seen well by such light as they could receive. The desirable condition of bright exhibits in less bright surroundings is not likely to be achieved unless room lighting and object lighting are separate and each is under full control. Room light may then be kept in a relatively low key, instead of being admitted or produced in an intense flux to be drawn upon in part for the task of lighting objects—a task no part of any flux can perform in the presence of the whole. Proper control of room lighting also disposes of problems that may otherwise arise from intensity differences between adjoining rooms.

The best relation between the color-temperature and the intensity of light may be indicated by the fact that in nature we are used to warm light of several times the intensity of the cold light we receive. Measurements under a great variety of conditions show warm, yellow light from the sun 4 to 10 times as strong, on the average, as cool, blue light from the sky. Taking this in relation to the indoor need for brightness contrasts of at least 2 to 1 but not more than 10 to 1 between object and background, and not losing sight of the fact that sunlight can be represented by the light from 2800°–3100° incandescent lamps in the presence of light from 4500° fluorescent tubes representing mixed light from the sky, we can reach a prescription for the artificial part of the lighting system: 4500° fluorescent light as required to bolster up moderate natural light to about 10 footcandles of general illumination; and 2800°–3100° incandescent light, at the intensity called for by the average diffuse-reflection factor of objects, to give from 20 to 50 footlamberts of exhibit brightness.

Incidentally, the use of natural light as part of the overall flux may permit of operating the artificial flux at a lower intensity (and therefore a lower rate of power consumption) than when the room is lighted by lamps alone.

POSITION OF THE LIGHT SOURCE, that is to say, of the light opening or luminaire, has long been a major concern for both the negative purpose of preventing glare and reflections of glare, and the positive purpose of placing light as required. However, the range of choice in any situation could not be great at a time when thinking was in terms of all-purpose natural lighting, and when inevitably top lighting meant a skylight, side lighting meant a row of low windows, and diagonal lighting meant high windows or perhaps a clerestory. Now this is changed by several factors that have newly entered into the lighting calculation—notably, improved lamps, prismatic lenses, successful diffusing glass, and, not least, the advent of modern style with its free and direct meeting of practical requirements.

So far as position of source is concerned, the preventing of direct and reflected glare has been a matter of keeping light openings, luminaires, and indirect lighting coves and panels away from points where the visitor could see them, directly or by reflection, in any ordinary way of viewing exhibits. This effort helped to extend the use of skylights for wall displays, of high windows for free-standing displays with mostly vertical reflecting surfaces, and of low windows for table displays with mostly horizontal surfaces; but in connection with mixed displays it did little but fortify the conclusion that nothing really works—least of all artificial means which as then employed were hardly more than aids to light openings in doing their job, or what was thought to be their job, of lighting everything.

During recent years this situation has been upset by the development of artificial means that can light exhibits acceptably and that have had the further effect, through attendant advances in understanding of lighting problems, of giving windows a specific task that they can perform acceptably. In consequence of the changed assignment and by leave of modern style, windows began to take unaccustomed positions in walls. And skylights, no longer required by the architect to relieve himself of the problem of fenestration, have begun to be judged on their practical merits in relation to their whole cost. We shall see, in sections following, what all this has brought in the way of new arrangements useful to the planner.

Recently, be it noted, the erstwhile troublesome character of sunbeams has been overcome with diffusing glass that is able to break up the beams before they can paint blinding patches on walls and floors. This advance has relaxed the need for orienting the building as a whole, and has thus favored further change; but on the other hand it has increased the effectiveness of skylights and has thus become a factor for holding the status quo in one respect at least.

Meanwhile, with the better museum observance of sound principles of lighting, notably in regard to relative brightness, lighting problems can be considered realistically from the standpoint of the particular things to be lighted. Two kinds of displays, those of paintings and sculpture, have had most of the special attention in published discussions—the latest, which gathers in earlier work, the report already noted on *Art Gallery Lighting* (*Illuminating Engineering*, Jan., 1945).

Paintings and other flat objects hung against the wall require object light coming diagonally from above. The best angle in any case is between 15 and 45 degrees from the vertical. Small pictures, such as prints, that have to be examined closely, may be shadowed by the visitor unless the vertical angle of light is acute, approaching 15 degrees. The slender moldings that ordinarily frame such pictures are not likely to cast much shadow. However, large pictures with deeper frames may call for an angle nearer to 30 degrees. Objects of large area, such as tapestries, that have to be hung high, require the angle to be even greater, up to perhaps 45 degrees. Room lighting, in all such cases, should provide a general flux of diffused light introduced in ways that do not make glares or reflections; and part of this flux should be of daylight whenever this is possible. Conditions as to quality and quantity of light for objects and room should follow lines that have already been discussed. In the sections below on windows and on direct and indirect artificial lighting we shall see ways in which all these requirements can now be met; and in the section on skylights we shall re-examine the traditional means.

There is a common belief that, although paintings require light diagonally from above, prints should have side light. The origin of this idea in the old lighting regime is plain. Skylights, which were the accustomed lighting means for paintings, were also agents of the grand scale in museum planning; and prints looked like postage stamps when shown in skylighted high rooms. This difficulty can now be circumvented by the use of means other than skylights that give light diagonally from above.

Sculpture is the most exacting class of material, at least in the art museum, because the delicate modeling and texture of its surfaces must be revealed by the lighting. Here again a diagonal directed light from above and a general flux of indirect light are required; but the difference is that the direction of the controlled light cannot be specified in general but must be determined exactly for each object by trial. This calls for adjustable spots overhead to give the dominant object light, and experience shows that two spots may be required—one to give dominant and one subdominant rays, both in the presence of the diffused flux of room light. This subject is discussed fully in the report referred to above, but there may be need to add that the principles there adduced (and summarized here) do not necessarily prescribe an obtrusively technical-looking installation of electrical fixtures. Good results are obtainable by very simple and wholly flexible means, as we shall see in sections following.

Efforts have been made to light sculpture entirely by daylight, as with studio windows and diffuse-reflecting walls, or with both windows and skylights, but results have not been satisfactory. The principal drawback is that one light pattern has to do for everything. There can be no adjusting of the direction and intensity of beams, as with artificial lighting. The best way would seem to be that of lighting electrically from a system of overhead spots, and having indirect room lighting as well as high windows. The windows can be curtained to keep the intensity of their light within bounds, and there should be diffusing glass if sunbeams make problems.

Bulky objects in general, including most of the free-standing objects of decorative art, history, and science, are more or less like sculpture in regard to mass but unlike sculpture as to subtlety of form. For such objects the sculpture prescription is good, though it need not be followed so precisely in the directing of rays. There should be the same overall flux of light—partly natural, at best, in the daytime—and directed light from one or two spots in an overhead pattern of inset fixtures adjusted to work in pairs.

Case objects, or mostly smallish things behind glass, form another main category from the standpoint of lighting. Self-lighting of exhibition cases, now recognized as imperative, is the key to this problem; but case lighting is not yet entirely solved by case manufacturers, and the result has been a strong tendency in recent years for the museum to construct its own wall cases *in situ*. Recessed wall cases, built in place and employing metal-frame fronts as their only manufactured parts, are increasingly popular in museums, although metal-frame cases of a type with glass in the top and sides also, made to be recessed, give a better result. Recessed cases of either kind can be designed and installed to give exhibition space at the most favorable level and within desirable limits at top and bottom of the display zone (see pages 150 to 237). Recessed cases can be lighted from top and sides, and from below also if designed for this, with lamps placed outside the case proper and behind the screen that forms the front of the housing. In this way there is very little heating of the case interior, and the curator has freedom for adjustment of lighting to the requirements of the particular display. Free-standing cases have to be lighted by means of fixtures available on the market, and these are being improved as case manufacturers get into postwar production (see page 240).

There are three aims in lighting for case displays—to give the objects greater brightness than their surroundings, to keep the source of the object light out of the visitor's sight, and to avoid or override reflections of room lighting sources in the glass of cases. Ordinarily, 20 or more footcandles of object lighting are required to give enough brightness contrast in the presence of say 10 footcandles of room lighting; or the relationship may be equivalent to this but at a higher level. What has been said about color-temperatures in artificial lighting holds for case installations. Object light may well be warmer than room light; either 2800°–3100° incandescent lamps or 3500° fluorescent lamps give good object light in the presence of room light from 4500° fluorescent lamps.

Lighting of cases for habitat groups and dioramas is a part of the skill of the preparator, maker of these displays. Suffice it here to warn against planning for any use of natural light inside such cases, whether large or small, and to remind the planner not to neglect general lighting of the room in which groups or dioramas are shown. Light that spills from cases of any kind is not enough to light an exhibition room. To keep contrasts and reflections within bounds there should be provision for lighting a hall of groups to at least 2 or 3 footcandles. Neglect of this is neglect of brightness contrast, and the result is the familiar dark chamber with rows of overbrilliant artificial landscapes.

WINDOWS are the traditional means of letting air and light into buildings; but for museums they are of limited usefulness since natural ventilation is restricted by air conditioning, and natural lighting is made into a special problem by artificial lighting. In consequence windows tend to be less and less important for the most familiar purposes, although they hold their ground very firmly in other ways. The purposes that are still good, as one may readily guess, are those of giving reassurance by letting people look out, and of making favorable conditions for artificial lighting by providing an admixture of natural light during daylight hours. In this role windows are unrivaled by any other kind of light opening.

The difficulties that windows have long caused in museums by setting up glares and reflections, as well as by vetoing generous width of rooms, are well known. Placed low along one side of a room, according to the conventional arrangement, they are reflected on surfaces facing them and they outshine wall spaces around them leaving for relatively satisfactory exhibition use only those parts of end walls that are not consumed by doorways. Rooms lighted by such windows can rarely be over 30 feet wide and usually not much over 20 feet wide from the windows to the opposite wall, since one and one-half times the height of window tops (which should be at the ceiling) has been considered the maximum, and width about equal to the height has been found still more satisfactory. If such a side-lighted space is divided transversely by partitions to increase the best wall space, the resulting semi-cubicles are small and cramping, like the old-time cabinets of European museums. Efforts to improve the lighting by splaying the transverse walls have added to the crowding and have made reflections worse. In short, the ordinary window-lighted room has been found disadvantageous in too many ways, despite the value of windows as otherwise comforting things that, for art museums, "approximate most closely the conditions under which works of art were originally shown when they formed the contents of palaces, houses, and churches."

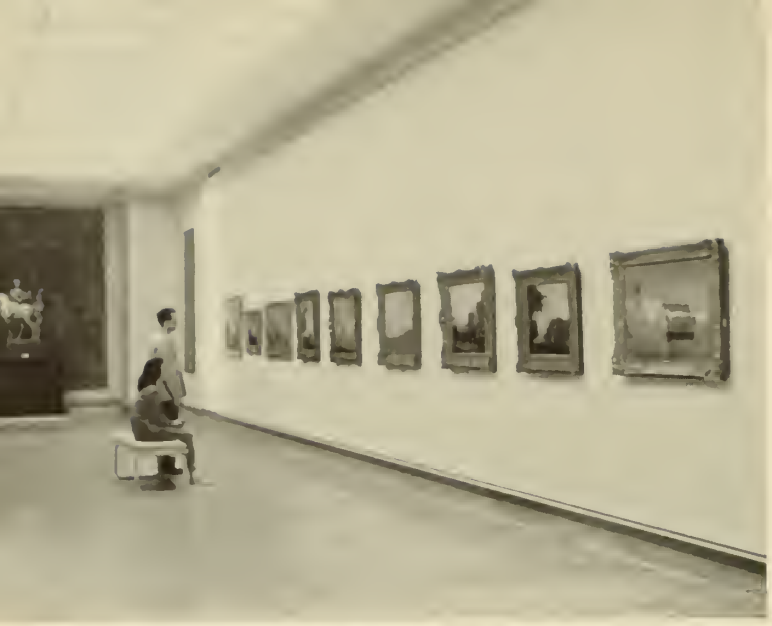
Such considerations have promoted the employment of other means, even at great disadvantage and sometimes also at considerable cost for construction and upkeep. One result has been an excessive use of skylights in spite of widespread dissatisfaction with them. Another has been a continued effort to get good results from the clerestory, the monitor, and especially the inverted monitor, which last has taxed the ingenuity of the planner without gaining much acceptance. High windows have given good results for some purposes, as we shall see, and these

Courtesy Art Institute of Chicago

WINDOWS PROVIDED WITH VENETIAN BLINDS, AIDED ALWAYS BY ARTIFICIAL LIGHTING WITH LAMPS FOR SPOTTING OBJECTS

HIGH WINDOWS AID IN ROOM AND OBJECT LIGHTING BUT NEED VENETIAN BLINDS TO TEMPER DAYLIGHT

Courtesy Cincinnati Art Museum



Courtesy Cranbrook Academy of Art, Bloomfield Hills, Mich.

CORNER WINDOW, WITH INDIRECT ARTIFICIAL ROOM LIGHTING, MEETS HUMAN REQUIREMENTS. OBJECT LIGHTING IS REQUIRED

have increased in use in new buildings and also in older buildings that have had the lower sashes of their tall windows blocked out. But only after the adoption of modern style could the search lead to a method that would remove from natural side lighting the principal difficulties previously encountered, and that would enable windows to compete successfully with skylights for the crucial purpose of lighting picture galleries.

Before getting on to new uses of windows, be it noted that accustomed uses are still good under some museum conditions. There are scores of small museums, mostly of history, in little buildings of domestic character lighted accordingly by windows; and in such simple surroundings there is little reason to depart from this manner of room lighting—provided that artificial lighting is employed to give exhibits the required brightness. Also, there are some kinds of relatively large displays, typically in museums of science and industry, that are made up of free-standing objects with diffusely reflecting surfaces and with little or nothing behind glass, that can be seen very well in a room that has tall windows and some accompaniment of artificial lighting.

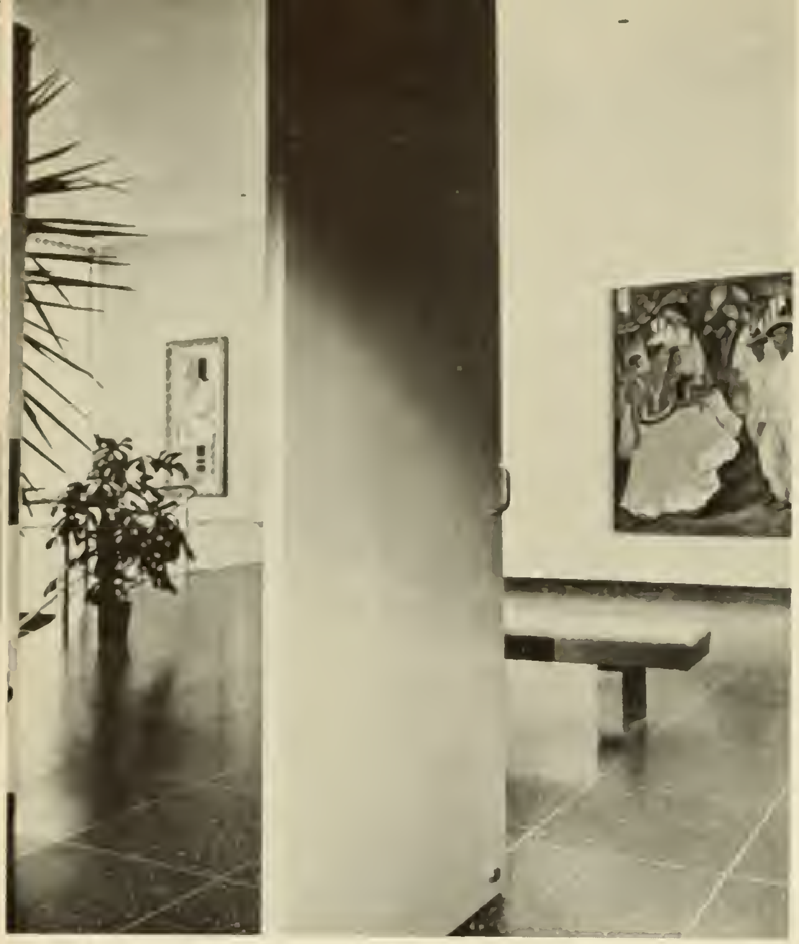
Windows placed high, with their sills well above eye level and usually eight or more feet from the floor, are also useful. Many of such windows are products of remodeling; but, whether new or old, they seem quite satisfactory for vertical displays if glass fronts of exhibition cases do not rise much above the five-foot level. In fact, this scheme is little different from the characteristically modern use of high bands of glass in ribbon windows.

Experience indicates that ribbon windows are most useful in rooms with comparatively low ceilings. A continuous band of glass along one wall of a room above the exhibition zone (say from the 8 or 10 foot level to the ceiling at 12 feet or more from the floor) will admit as much light as windows of twice that height spaced in the usual way with about equal total areas of glass and intervening wall; and this can mean a ceiling height of 12 or 14 feet instead of 16 or 18 feet, which is an important gain for many exhibition purposes. Also, the newer arrangement gives more uniform room lighting since it removes the possibility of contrast between bright openings and dark areas of wall. If the window band extends to the ceiling, as it should, there need be no dark wall band above it. And if artificial lighting is provided for the lower wall, as it should be, there need be no dark areas under windows. The recently remodeled New York Historical Society has several rooms in which high ribbon windows do their part very well. Diffusing glass is sometimes employed in windows to break up sunbeams, but diffusing glass used in this way may become a secondary source of brightness that is more disturbing and difficult to avoid than the sunshine itself. Prismatic glass, perhaps in the form of blocks which throw the light to the ceiling, may be used to good effect. Instead of being in the plane of the wall, ribbon windows may be set at an angle to the vertical, like continuous studio windows. This arrangement will appear in Wright's building for the Guggenheim Museum in New York, where bands made up of glass tubing set between metal strips are to occupy the angle between the exhibition wall and ceiling along the entire ramp forming this museum's single long gallery. However, considering all the functions of light openings, it is doubtful whether high windows of any kind have more than limited usefulness.

The most important new method of using windows, mentioned above, is one that grows out of our present understanding of what natural lighting is for. It had its first bold adoption in Saarinen's Cranbrook Academy of Art (1942) after some hesitant, perhaps even undeliberate, uses of it here and there in remodeling. This is a scheme which, for want of a better name, might be called *corner lighting*. And kindred to it is another scheme that might be called *end lighting*.

Corner lighting—most useful for a room of moderate size—requires only one window, located at or near one end of a long wall. The opening admits a token of light transversely in a way that sets up no serious glare or reflection. In Saarinen's building of 1948 at Des Moines this scheme was modified, without apparent gain, by placing the window at some distance from the corner of the room. The window, wherever it is, can be of any appropriate design, but in a modern building it may extend from floor to ceiling. With the aid of adjustable drapes or Venetian blinds the natural light can be kept under control. Objects on display are lighted artificially according to their nature, and the room is lighted in part artificially by day, and of course entirely so by night. These arrangements lend themselves to any kind of installation, but they are especially important for the class of objects which has given the planner most trouble, namely paintings. Corner lighting is a successful method for picture galleries whether they are on the top floor or any floor below, and therefore it permits the architect to put the principal floor of exhibits at ground level even in a museum of fine art that is several stories high. The overweening importance of this will be noted in the chapter following; but here be it said in a word that corner lighting, and end lighting equally, have opened the way for organization of space literally according to functional requirements rather than, as so many times in the past, by the dictates of one or another method of top lighting that demanded a low building.

End lighting, another special arrangement of windows, is not as new as it is newly and surprisingly effective now that museums know how to use it in connection with artificial lighting. By this scheme the daylight enters at one end of the room—through a short wall, rather than through a long wall in the customary manner of fenestration. The opening may occupy the entire end of a relatively long and narrow space, and the glass may then extend from floor to ceiling and from one side wall to the other, suggesting panels of glass in the structure wall. This requires the use of drapes or Venetian blinds to regulate the natural light supply. The arrangement gives a very large proportion of wall area for display, since the only points at which there can be reflections are close to the windows on the side walls, and on the small wall at the opposite end. Also it favors flexibility since a large expanse of floor can be lighted from one wall and the area divided at will by screen partitions set endwise to the source of daylight. End lighting has been used repeatedly in exposition buildings, but museums overlooked it until it appeared to good advantage in remodeled structures and then in a few new buildings. There is an example in the remodeled building of New York's Whitney Museum, and another at Boston's Institute of Contemporary Art.



Courtesy Museum of Modern Art, New York

EFFECT OF END LIGHTING PRODUCED BY WINDOWS OF STAIRWAY. ARTIFICIAL TOP LIGHTING FOR ROOM AND SPOTS FOR OBJECTS

Several spaces are so lighted in the Museum of Modern Art, New York, and a like arrangement was shown in Saarinen's prize-winning design for a museum of modern art in Washington.

The subject of natural side lighting, in ways new as well as old, calls for three important postscripts—on light diffusion, on screening, and on heat insulation.

Diffusion of natural light is accomplished by the use of diffusing glass that is able to break up glare, and also by diffuse reflection especially from the ceiling and walls of the room. Until the glass industry had developed successful diffusing glass (notably, products discussed below, here and in connection with skylights) museums were at the mercy of brilliant daylight, but now that there is effective diffusing glass even direct sunlight can be distributed through a space. This is greatly assisted, with wall openings, if the openings reach to the ceiling; windows with wall space above them should be wholly of the past. To help the ceiling do its work there are now prismatic glasses, in panes and in blocks, which throw much of the entering light to the top of the room for diffuse reflection from there.

Screening, with drapes, Venetian blinds, diaphragms and other devices, is important as a way of controlling light—from hour to hour as outside conditions change, or from time to time as exhibit requirements change. In the era of tall windows for all-purpose lighting, the museum window shade that rolled at the bottom was a flimsy device for turning a tall window into something like a a high window. The result was never satisfactory, partly because the purpose itself was rather primitive. The present way of regulating light is to change the amount of light at all levels of the opening, rather than to attempt correction of the architect's work by changing the shape of the hole. Venetian blinds are thus the best device for adjusting window light. These blinds, which by the way have been greatly improved of late, can regulate the light flux through every square foot of window. They reduce the light that passes, and at the same time throw part of the light to the ceiling and reflect part of it diffusely in other directions. The blind should be received into recesses all around. At the top the pocket that takes the bundle of slats when the blind is drawn may be set above the ceiling level; at the sides, the ends of the slats should also be taken into grooves which cut off leaks of light; and at the bottom the lowest slat when the blind is down should be able to go out of sight below the sill, or below the floor in the absence of a sill. Whether there should be a sill above floor level must depend in part upon climate, since in cold weather any wall opening, even in air conditioned buildings, may need to have a radiator below.

Drapes are often employed as alternatives to blinds, and sometimes with them. They have their chief usefulness, aside from decorative effect, in cutting off a window at times when its light becomes troublesome or there is darkness outside.

Diaphragms, to reduce light openings, may be used in many ways for adapting natural lighting to special needs. At the Museum of Modern Art the bars that carry the panes in large areas of glazed wall can also take panel boards, of cement and asbestos composition, inside the glass. Adjustability of this kind is so useful in a changing and growing museum that architects have proposed entire walls of glass with flexible inner screen walls having openings where they are wanted. Whether this plan, sensible as it is, will be widely adopted is hard to say; but in any case it should be noted that many museums have long since adopted the idea for period rooms in which there is an inner paneled wall containing period windows and outer glass that gives light to several of the smaller openings. Detroit has a light-mixing chamber between two walls in one place, whereas Philadelphia omits the outer windows at some points and uses the space between the two walls to light artificially through inner period windows.

Insulation of wall openings, by double glazing or use of blocks or insulating panes, is important to minimize heat loss in winter, as well as gain in summer, and to prevent condensation.

Double windows are familiar. The Worcester Art Museum gives a good example with double panes in hinged frames of bronze. Outer sashes should open outward, or they will be forced by the wind and will whistle and let in dust. Sliding sashes, whether single or double, are not good. Some double windows are fixed, but this is not advantageous since windows should be free to open for cleaning. The Fogg Museum has sashes held by screws.

Insulating glass, which was on the market before the war, and is now obtainable in a new form, should be of great usefulness to museums. Its first museum appearance was at the Museum of Modern Art where an imported product, *Thermolux*, (then obtainable from Italy) was extensively employed. This material has a double pane with intermediate packing of spun glass and is therefore a diffusing medium as well as a heat and sound insulator. It filters out a disproportion of the red end of the spectrum, however, and therefore delivers a rather cold natural light. A new product, *Thermopane*, which gives truer light transmission, is now manufactured in this country by Libbey, Owens, Ford Glass Company, Toledo. This glass has two layers separated by air space. Each pane is held around its margin by a strip of lead alloy having expansion properties that prevent mechanical strain. Panes are available in a range of standard sizes, and can be supplied in special sizes and special shapes. The indoor surface can be sandblasted or otherwise treated for diffusing effect.

Glass blocks, which are heat insulators and sound insulators as well, have been used to some extent in exterior walls of exhibition rooms, as at the New York Historical Society; but their more natural use seems to be in walls of lobbies and stairways. An arrangement that perhaps has not been sufficiently explored is the use of small areas or bands of transparent or prismatic glass blocks in larger translucent panels of the same material. Printed matter on glass blocks distributed by the Pittsburgh Corning Corporation, Pittsburgh, and other manufacturers, is worth examining. However, one should remember that glass block panels are not windows and should not be used, or not used exclusively, in offices and other workrooms.

CLERESTORY WINDOWS, which look out from the top of any high central space over the roofs of flanking spaces, are both instruments of room lighting and parts of a useful architectural feature. The natural light they admit serves very well in the contributory role that belongs to natural light. The openings give no view to the outside world, but this failure is less serious in connection with a large space than with a small room.

An important merit of the clerestory is that it makes unnecessary the treatment of a central court as a high skylighted space. Gilman long ago dealt in a decisive way with the skylighted inner court (*A Museum Without Skylights* and *Basilica or Temple*, both included in the book, *Museum Ideals*). "A roof, not walls, constitutes a house," he said; and time has strengthened his case for clerestory windows as opposed to a ceiling of glass.

There are central clerestory halls in many museums—the Museum of Fine Arts at Boston and the Buffalo Museum of Science, for instance. A good example of a modern type can be seen at Dallas, where the sculpture court has high horizontal bands of glass blocks instead of high windows.

CLERESTORY WINDOWS, LIKE ANY HIGH WINDOWS, ARE CONTRIBUTORY MEANS IN ROOM LIGHTING
Courtesy Buffalo Museum of Science

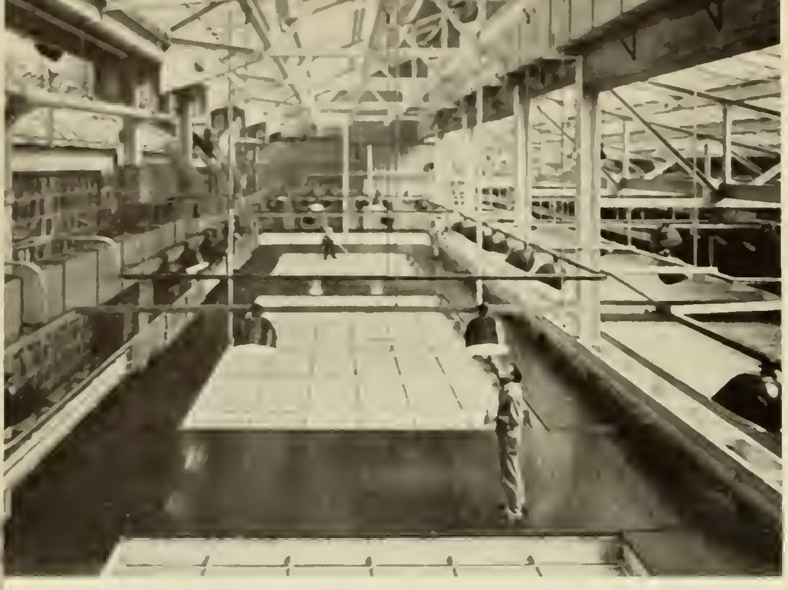
SKYLIGHTS have long been the principal means of lighting picture galleries. Our first skylights were little peaked cages, or lanterns, crowning the vault of the ceiling—copied in early American art museums from still earlier European examples, notably, Robert's famous project of the 1780's for remodeling part of the Louvre, Sloane's Dulwich Gallery of 1814–16, and von Klenze's old Pinacothek of 1826–36 at Munich, which in turn may have been suggested by little overhead openings in Italian palace galleries like the Museo Chiaramonti of the Vatican. Small skylights were adequate under the bright skies of southern Europe, but in America they had to be helped out by windows, as they were in the old Corcoran Gallery begun in the 1850's. Later buildings had larger skylights; and then there had to be a suspended horizontal screen, or velum, above the visitor's head to cut off the flood of light in the central part of the room. With the advent of artificial lighting, about 1880, came installations of electric lamps that were contained at first in open troughs hung from the lower margins of the skylight. After the turn of the century the lights were relegated to the now familiar attic, separated from the gallery below by a diffusing sash of glass. "The elimination of the suspended screen and the troughs of light," said *The New York Architect* of Hartford's new Morgan Memorial in 1910, "give a sensation of an open airiness which is unusual." Subsequent evolution of the skylighted room has greatly increased the height of the attic chamber, providing it with more and better artificial lighting equipment and with louvers to intercept direct rays of the sun, and has enlarged the sash at the ceiling level and improved diffusion.

Skylights came into general adoption for galleries of paintings because of an advantage that was unique in the days before good artificial lighting. They could flood a room with light and yet leave all walls free for display. Too much of the light might be in the wrong place, notably on the floor and the visitor; but windows which were the alternative gave bad distribution also, and they set up reflections much worse than those of skylights. Clerestory windows could not compete because of the dimness of their lighting, to say nothing of their special character architecturally. Monitors, and inverted monitors such as were later advocated for "top-side" lighting, were just too cumbersome to find much favor. Thus skylights held the field by default, although their cost and other disadvantages were well recognized. "Top lighting," wrote Meyric Rogers in the 'twenties, when top lighting meant only skylights, "though rather expensive in construction and open to many objections, still seems to be the best method of lighting picture galleries," (*Modern Museum Design*, *Architectural Forum*, Dec., 1927).

However, developments of recent years have changed the status of skylights. The passing of all-purpose lighting and the relegation of natural lighting to a contributory role, have exposed skylights to successful competition. The employment of modern style has encouraged arrangements that cost much less than skylights. And the evolution of museum work is forcing expansion of the building upward, while it also gives emphasis to the importance of keeping exhibits near the ground.

The cost of skylights is relatively, and sometimes absolutely, enormous. Initial cost includes the cost of an attic story, often of cubage between one-third and one-half of total cubage in a building of the familiar one-floor or two-floor pattern. It includes the cost of huge expanses of special glass, above and below the attic, and of electrical installations powerful enough to light one story from another. Also it should be known to include, in the long run, an incalculable cost arising from distortions in buildings that skylights always demand. Maintenance cost includes a congeries of items. There is expense for stopping leaks and replacing breakages; skylights even in some of the newest buildings give much trouble from daily expansion and contraction. There is the cost of a great deal of cleaning. Four or five cleanings a year of glass —acres of glass in the larger museums—may be necessary to prevent light reductions up to 30 or 40 percent due to dust and dirt. This applies to the inner diffusing sash as well as to the outer skylight, and here the cost of dust partly includes the cost of any extra artificial lighting so made necessary. Other large items are for attic ventilation, for the cooling load to offset heat admitted in the summer, and for the heating load to replace excessive heat loss in winter. Skylight attics may heat up to 130° or more unless they are ventilated, and rooms below them may go to 100° or more unless they are cooled.

Whitewash on skylights helps some, but not enough; and spraying skylights with water is ludicrous as well as ineffective. Heating attics in cold weather is like heating an adopted part of the out-of-doors, and this is no figure of speech when it comes to melting snow on the roof with special unit heaters. Altogether, the cost of skylighting is far beyond the means of most museums, and should be beyond the means of every museum that has work to do with its money.



Courtesy National Gallery of Art

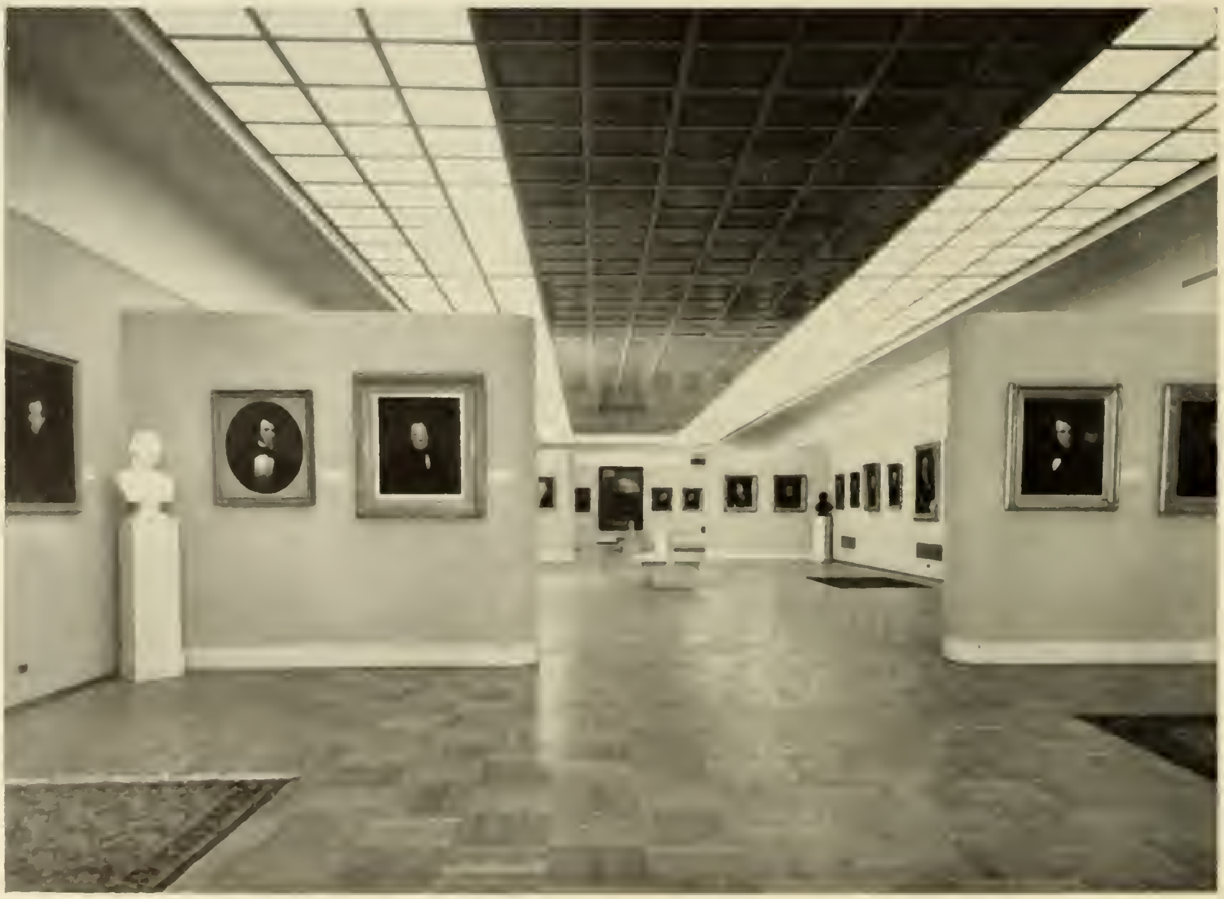
ATTIC REQUIREMENTS OF SPACE AND EQUIPMENT FOR SKYLIGHTED GALLERIES ARE HERE MET WITH COMPLETENESS

The relation of skylights to organization of space is examined in chapters that follow. In a word, adoption of skylighting practically closes the question of how the building is to be arranged. It dictates the one-or-two-story-and-basement *parti*. It makes over-crowding in the basement inevitable; and it does this regardless of the size of the building since the problem is one of relative requirements which no museum, however large or small, can long ignore. It commits the institution to the past by cutting it off from the type of development that the future has in store.

Also, the distribution of light achieved by skylights leaves something to be desired. In winter months, or on dark days at any season, and in late hours of the afternoon at all times,

A DEVICE OF SKYLIGHTING THAT SCREENS FLOOR

Courtesy New York Historical Society



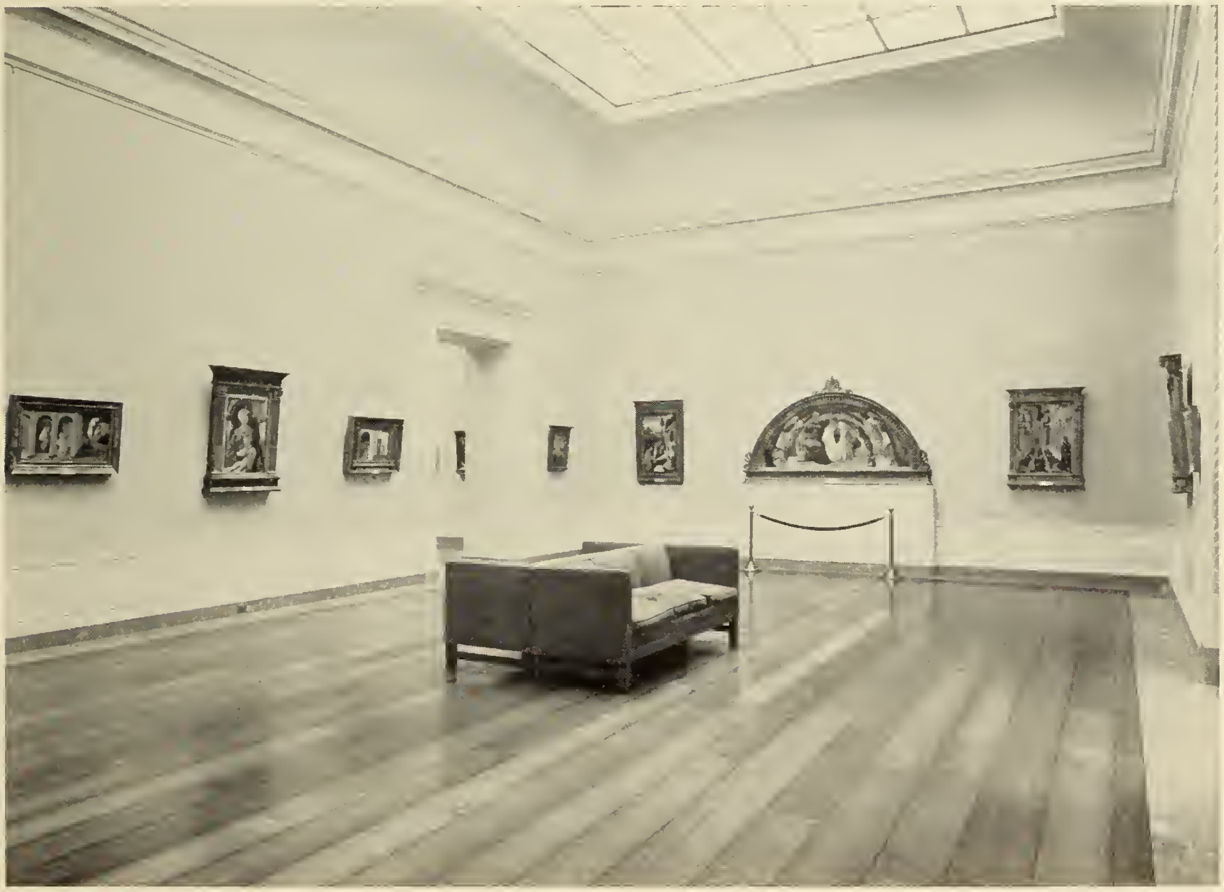
natural top lighting has to be supplemented artificially in a most inefficient way. In bright hours of bright days most natural top lighting produces more or less glare in the middle of the room, and so sets up extra duty for the artificial lighting that must give the walls their proper relative brightness. There are various devices employing louvers to cut off excessive light, but these are not very effective and are such a nuisance to operate that they are commonly neglected. Also they are costly. "Why admit light at great expense," asks Stein, "and then proceed to shut it out at even greater additional expense?" But even with full correction, skylights still fall short because they do not provide the reassurance that comes of seeing out. They are said to "drown the visitor as in an aquarium."

And, lastly, even the skylight's virtue of not using wall space is challenged by other ways of *not* doing this. Corner lighting is very economical of wall; and high windows, made effective by the aid of artificial means, do not in the least encroach upon the picture-hanging zone.

Quite understandably there is now a strong reaction against the skylight, and there are indications that skylights may take on some new form that can be employed as required to help in lighting any space with no other

SASH WITH PERFECTED DIFFUSING GLASS AND THE REQUIRED PROVISIONS ABOVE

Courtesy National Gallery of Art



space above. Under modern style treatment there may well be parts of a building that meet this description in the presence of other parts that rise several stories higher. Now that effective diffusing glass is available, and that artificial lighting can be carried out more successfully from the ceiling than from an attic, and that skylights can be designed with only enough space above the diffusing sash to let the skylight have its pitch against the weather, small and adaptable skylights of more or less free form may come into general use. Already there are examples of this, as at the Museum of Modern Art where narrow skylights appear in setbacks of the building. But the old-fashioned skylight—a roof of glass over a whole story of empty attic, that could call the tune to the designer in his planning literally from roof to basement—seems destined to go.

There can be little point in giving here more than a brief account of the *construction of skylights*. The outer, self-supporting, steel frame (or special aluminum frame) is of standard construction, manufactured in many cases by H. H. Robertson of Ambridge, Pennsylvania. In some climates there should be outside guards for hail. The frame holds wire-glass, probably from the Pittsburgh Plate Glass Company, and the panes of this glass facing south are sandblasted on the inside. Glazing is without putty. Condensation gutters that follow the glazing bars inside each pane of glass lead to discharging weep holes that pierce the frame at the curb. Although skylight frames used to be set like sash in exposed slopes of roof, they are now constructed as trussed cages, gabled or hipped, resting on steel joists that surmount a low curbing wall. The slope of the glass is not less than 3 in 12, or water will not run off properly, and 6 in 12 is better. Sawtooth skylights have been tried, but they are not satisfactory. There is a passage around each unit of skylight on the flat roof, and the whole is screened by a surrounding parapet.

The attic chamber below the skylight has to be wastefully large—6 feet or more high at the curb and up to 30-odd feet high at the ridge—to provide for the customary installation of lamps. This space is floored by a diffusing sash, with a steel frame set in a reinforced concrete frame. The sash area, as a rule, is about 75 percent of the ceiling area of which it forms a part. There should be an attic catwalk around the diffusing sash, and a rolling bridge for cleaning. The rectangular panes, not more than 2 to 3 feet on a side, are of diffusing glass and are bedded on T-bars of the steel frame. All joints should be snug to prevent air leakage so that the attic may be ventilated independently. At the National Gallery, with skylights of superior design, the diffusing panes are set in rose metal, a non-expanding alloy used to prevent shattering of the glass under stress of expansion and contraction in the frame.

Lighting by lamps from the attic chamber is considered in connection with direct artificial lighting (page 101).

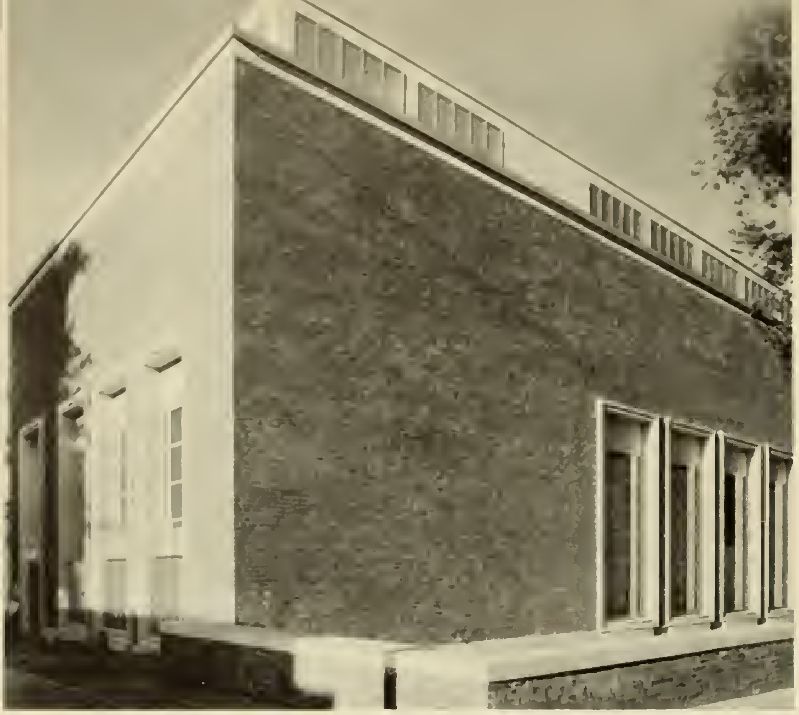
Diffusing glass has been much improved in recent years. The older ground, etched, and figured glasses that have been used in skylights were not very successful in breaking up glare from the sun and floodlights or in obscuring the sight of roof trusses. Moreover, they were somewhat greenish, transmitting color badly. The less familiar smooth, translucent opal glasses were also in some cases lacking in fidelity of color transmission. But a recently developed type of glass is satisfactory in all-round performance. This is *Crystalex*, made by the Pittsburgh Plate Glass Company, which is a rough-rolled and sandblasted water-white plate glass, capable of diffusing even direct sunlight and also of transmitting efficiently with little color distortion. *Crystalex* was adopted for the diffusing sashes of the National Gallery after tests in an experimental room made ready for the purpose before the building was finished. It is blasted on one side only, the lower side in position. Treated also by the so-called *Herculite* process of heating and then cooling by air blast, it can withstand from 4 to 5 times the mechanical stress and thermal shock of ordinary plate glass and will pulverize instead of shattering, if broken. The chief disadvantage of *Crystalex* glass is its cost, which is several times that of ordinary, rolled, obscuring glass.

A word must be said about some recent methods of overhead screening to cut off rays that would otherwise go to the floor. In the last century, as we noted, a translucent velum was hung over the heads of visitors in the central part of the room. When diffusing sashes came into use, the same purpose was sometimes served by introducing an opaque or translucent area in the central part of the sash. European museums have repeatedly adopted this scheme, and in this country a recent example is given at the New York Historical Society, where central panes in remodeled skylights of painting galleries are darkened by fiberboard panels. In the Fogg Museum of Art and some earlier buildings, a like result was sought by extra-etching or extra-blasting the appropriate panes of glass. And in the Whitney Museum, New York, there is a kindred arrangement with a central opaque ceiling and a surrounding band of glass screened by longitudinal louvers. The more complicated of such devices are distracting in their artificiality, and no arrangement of the sort seems satisfactory. Even the simple darkened central area of a diffusing sash hangs threateningly overhead like a suspended mass. It would seem that the point at which a skylight is divided into several small diffusing sashes—which is about what the indicated special arrangements come to—is the point at which a modern artificial lighting installation, aided by some convenient natural lighting method such as the corner window or end window, is indicated.

MONITORS AND INVERTED MONITORS of more or less complicated form have been devised for lighting gallery walls without over-lighting the floor. They serve this specific purpose rather well, but they suffer from being rather conspicuous, not to say distractingly unsightly. In addition, these devices have one disqualification in common with skylights, since they do not always lend themselves to rational organization of space.

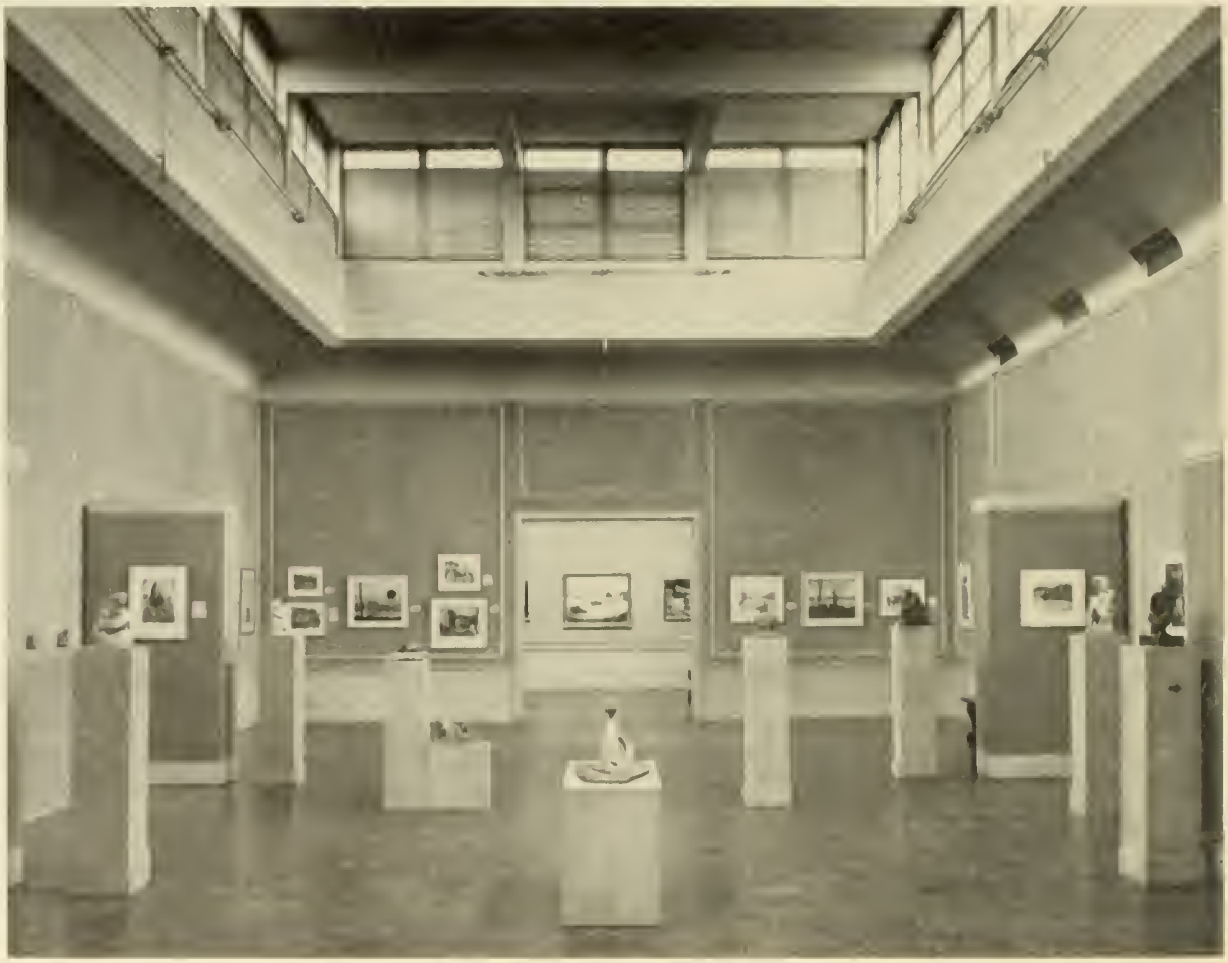
The monitor is a large rectangular lantern crowning a top-story room, and is formed by having the central part of the ceiling raised above a band of windows. The windows on either side of the monitor give light to the opposite wall of the room below. The best examples in this country are at Portland.

The inverted monitor, if it existed in simple form, would be a sort of box, hung from the ceiling of a top-story room, with windows in each side of the box giving light to the wall at the same side of the room. An elaborate inverted monitor peculiar to museums is the familiar, though not common, arrangement for so-called "top-side" lighting. It requires a roof depressed along the axis of each room and having windows on either side, set at an angle. The system is attributed to S. Hurst Seager whose papers, mostly in British journals during the 1920's, coined the term *top-side*. Seager urged the construction of galleries lighted on one side only by what would amount to half of an inverted monitor, the other side of the room being treated as a corridor in which visitors could move in semi-



obscurity. After experiments with a model gallery lighted by an entire inverted monitor, the British Department of Scientific and Industrial Research, in 1927, again favored the half-monitor used for only one side of the room. However, in a later paper (Montreal, 1934) Nobbs worked out a ponderous and still unproven arrangement for reflecting some of the incident light back to the darker side. There are no good examples of either scheme in this country; but in Europe, where artificial light is not expected to do what we now consider its daytime part, there are some well

MUSEUM OF ART, PORTLAND, ORE., WITH MONITOR OVER SECOND STORY GALLERY. EXTERIOR (ABOVE) AND INTERIOR (BELOW) OBJECT LIGHTING HERE NOT IN USE



known installations of top-side lighting—most notably in the Duveen gallery of the National Gallery, London, and the Marlay galleries of the Fitzwilliam Museum, Cambridge; and in art museums at Berkenhead and Southampton, England, at The Hague, and at Malmö in Sweden.

When one notes how effectively artificial fixtures of simple design can deliver light from the ceiling in accordance with the top-side principle, and how easily daylight can be added in other ways, one sees how outmoded are these involved devices of the days of all-purpose lighting.

COST OF LIGHTING is a considerable matter for museums, and it should be looked into realistically. The electric power bill gives the most easily discoverable item of lighting expense and not surprisingly it gets the most attention. Lighting bills run from a few hundred dollars a year for some of the well lighted little museums to upwards of $25,000 a year for several of the large museums. Annual figures between $1,000 and $5,000 are reported commonly. But these amounts cannot be judged by themselves, since lighting of any kind has to be paid for. "The cost of artificial light now competes favorably with the cost of daylight indoors," says Matthew Luckiesh (*Light Vision and Seeing*), " . . . but the daylight habit is strongly entrenched and many windows, skylights and light-courts are installed where they cannot be justified." In a study on *The Cost of Daylight* (*Transactions of the Illuminating Engineering Society*, 1923, 130–133) Luckiesh and Holliday report initial costs of construction for natural lighting to be from 80 to 180 percent higher than for artificial lighting, and the operating costs, considering heat loss and other factors as well as operation and maintenance, to be something like 135 percent higher for daylight.

In spite of evidence to the contrary, it is hard to dislodge the notion that the use of daylight is cheap because daylight itself is free. "The light of the sun is there; why not use it?" says many a museum director, perhaps looking inscrutably at skylights which are daily refuting "the accepted but erroneous idea that natural light costs nothing or at least not much." (*The Lighting of Museums*, *Architecture*, Dec., 1923, 416). In the course of recent tests the Metropolitan Museum determined that: "Counting the loss of investment income at 4 percent in lieu of depreciation estimates, the present-day added annual cost of glass skylights installed and maintained is approximately $550 per 1000 sq. ft. of roof area." (Laurence S. Harrison, *Architectural Record*, Dec., 1948, 139.)

The cost of lighting of any kind depends in part upon the particular means employed. Where there are broad expanses of glass, for instance, there are likely to be considerable heating and ventilating costs in addition to the more direct costs of lighting. Or where there are great lamps toiling inefficiently to do what smaller lamps in an up-to-date installation could do easily and better, there are bound to be unwanted problems having to do with heat. On the other hand, improved fixtures that can be serviced easily will circumvent a good part of the costly difficulty reported by one museum which finds its 12 footcandles of lighting on walls reduced to 8 footcandles by aging of lamps, and soon to 3 footcandles by accumulation of dust.

With natural and artificial means used in combination, both the lighting and heating costs can be kept in moderation. But where natural light has more than it can do, or where artificial light has more than it ought to do, needless costs are incurred.

FLUORESCENT AND INCANDESCENT LIGHTING, or the new and the less new means of artificial illumination, invite comparison. Fluorescent lighting has come into very wide use, as shown by reports that there is some fluorescent lighting of exhibits in a majority of museums, that from 5 to 25 percent of fluorescent lighting is common, and that 50 percent or more of fluorescent lighting is found in a few museums. This new instrument is developing rapidly, and statements about it today are outdated tomorrow; but for a good review of a recent state of the art, one can turn to the *Fluorescent Lighting Manual* by Charles L. Amick (McGraw-Hill Book Company, New York, 1942); and there are always up-to-date leaflets from the industry, such as General Electric's *Review of Fluorescent Luminaire Design.* In technical serials there are occasional summaries of interest to the layman—an example, *The ABC's of Fluorescent Lighting* by John T. Bailey in *Pencil Points* of Sept., 1941. And a very useful reference work on all branches of lighting and corresponding equipment is the *IES Handbook*, published (first edition 1947) by the Illuminating Engineering Society, New York. But only a manufacturer's data sheets can be quite up to date: momentarily, G. E. *Lamp Letter* of May 27, 1949 on *Slimline* fluorescent lamps of "big inch," "inch," and "little inch" diameter.

What most recommends fluorescent lighting is perhaps its luminous efficiency, which is from 2 to 5 times that of incandescent lamps (45 or more lumens per watt from fluorescent tubes, 10–21 from tungsten filament lamps). And in addition fluorescent lamps are cool, having only one-half or less of the total heat production of incandescent lamps for equal output, and only one-quarter of the radiant heat production. Fluorescent equipment costs more than incandescent equipment, but this handicap is much more than overcome by savings of between 50 and 60 percent of the lighting bill.

The color of so-called white fluorescent light is still spectrally incomplete and otherwise somewhat unbalanced in comparison with daylight; but, as noted (page 78), these characters can be passably balanced by use of "warm" incandescent light mixed with the "cool" fluorescent light. And, as we have seen also, this method has a special advantage in the opportunity it gives for approximating nature's accustomed cool general lighting punctuated by warm highlighting—a formula easily followed with fluorescent room lighting (in combination with some natural lighting by day) and incandescent object lighting. An early common idea that fluorescent light could not be strong enough for the room, but only for lighting in cases, came apparently from the old mistake of trying to light the room to a needlessly high level. Relatively intense lighting of a room by fluorescent luminaires is now within reach if it is wanted; and local lighting of objects by fluorescent means in the presence of room lighting of any kind can also be satisfactorily carried out. But the best results for most purposes seem to come from cool general indirect lighting by fluorescent lamps with warm local direct lighting by incandescent lamps.

Certain technical defects of fluorescent lighting, including the already partly overcome stroboscopic effect, or flicker, and the obvious crudity of parts of many fluorescent luminaires, are only matters of a little time. One has but to reflect that *wireless* fluorescent installation, with energy supplied by radiation, is already in prospect to see how easily this form of lighting can outrun its disadvantages of the moment.

The idea that fluorescent lighting is about to replace incandescent lighting entirely is quite uninformed. The two methods have different uses, corresponding to their natures.

DIRECT ARTIFICIAL LIGHTING, as employed in exhibition, used to be all-purpose lighting; but now it is mostly for the lighting of objects, leaving rooms to be lighted indirectly as a rule. The change has come about through development of fixtures of new types that have specific uses, and—by the way—that have to be used correctly to be effective.

Certain kinds of fixtures, whether old or new, are fairly well ruled out. Thus the hanging globe of sanded or translucent glass, once the most common of fixtures because of its high luminous efficiency, is now wholly obsolete for exhibition purposes. If hanging fixtures are wanted there are more useful types, as we shall see. However, the day of fixtures suspended from the ceiling, or attached to the ceiling or walls as exposed appendages, has passed. Exposed fluorescent tubes, no matter how up-to-date looking, are in fact no more appropriate to the purposes here considered than are hanging globes.

Attic installations of lamps with reflectors, placed under skylights and above ceiling sashes of top-lighted galleries, may continue in use where skylights are employed, although simpler and much more economical methods of lighting artificially from above have now been developed. For the attic type of installation, incandescent lamps are placed in four rows parallel to the four walls. Usually the row on each side is directed toward the wall opposite, its light impinging at eye level below; but in some attics the rows are near together and the lamps are directed to eye level on their own sides below. The lamps, with semi-concentrating reflectors, are of at least 150 watts or 200 watts, and are set 3 or more feet apart and 3 or more feet above the diffusing sash. The tendency has been toward use of larger lamps spaced for 100 or 150 watts per linear foot of wall. With the improvement of diffusing glass has come the adoption of 500-watt, 750-watt, or even 1,000- or 1,500-watt lamps, set correspondingly far apart and provided with floodlight reflectors. There may be extra lamps for general lighting. All of this arrangement, whatever its merits or faults, is part of the skylight scheme and at best can be no more acceptable than is the scheme itself.

False skylights are devices for getting some of the effect of skylighting, but without skylights. They eliminate roof openings, and can therefore be employed on lower floors; and instead of a gabled skylight attic they call for only a flat six-foot-high loft above a hung ceiling. This arrangement can be seen in more than a score of museums, most notably at the Nelson Gallery of Art in Kansas City where the main floor is lighted largely in this way. The principal advantages of the false skylight are only by comparison with the true skylight: the flat loft costs less than a skylight attic to build and to operate, and is less restricting in its effect on organization of

HANGING GLOBES ARE EFFICIENT BUT GLARING

Courtesy Walker Art Center, Minneapolis

DIRECTED SPOTS MAKE OBJECTS BRIGHTER THAN ROOM WHICH DEPENDS UPON LIGHT REFLECTED BY WALL FROM TROUGH

space. However, what the false skylight can do, other means can do better and more economically. Indirect lighting panels for the room together with direct lighting troffers for objects (see below for both kinds of fixtures) are preferable by far.

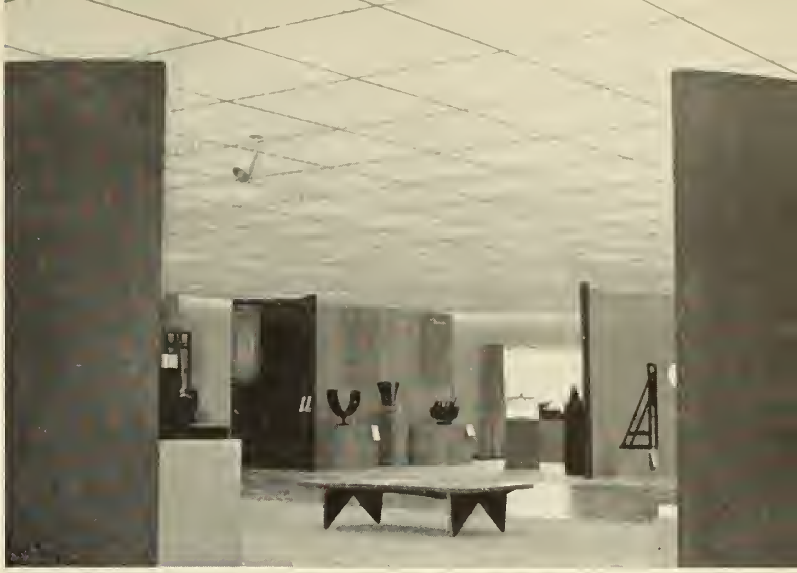
Spotlights of several kinds are now in wide use. The best known is the incandescent projector lamp, with self-contained reflector and adjustable socket. Lamps of this type can be set singly, perhaps in ceiling depressions, or (see trough lights, below) several may be placed in a multilamp luminaire—commonly an open trough, as at the Museum of Modern Art. A less conspicuous kind of spot, used at Cranbrook (shown page 74), is the semi-recessed "eyeball" type of fixture with access from the outside. This has an adjustable ball-and-socket joint, and its beam can be thrown to any point below. These or other highlighting lamps can be framed to a given small area such as the rectangle of a picture or the silhouette of a free-standing object.

Louvered lights are made in a variety of forms, employing incandescent or fluorescent lamps singly or in multiple. They throw their rays downward; and the area so illuminated may be of a few square feet or as large as the lower surfaces of the room. For a small spot, the usual means is an incandescent lamp in a fixture of concentric and crossed louvers. For lighting larger areas there are louvered trough lights that have their louvers arranged like partitions in an egg box, cutting off light from glare angles. For the widest distribution of light in a room there is the louvered type of ceiling.

Louvered ceilings, commonly referred to by the specific trade name *Louverall*, are suspended ceilings made of crossed strips of metal or plastic that come in rectangular units. Fitted together these units give an entire overhead grid through which light from lamps above them can pass at angles up to 45 or 50 degrees from nadir. From positions at a wider angle one sees only the illuminated surfaces of the louvers themselves, which thus light the room as a whole semi-indirectly while permitting objects to be lighted directly by lamps that are placed for projecting through the grid. In experimental galleries at the Metropolitan Museum, use has been made of ceilings of this type with marginal grids having louvers set at an angle to favor direct lighting of walls (Laurence S. Harrison. *Museum Lighting Studied in Laboratory. Architectural Record*, Dec., 1948). Louvered ceilings are produced by at least a score of manufacturers, including Louverall Lighting Corporation, Chicago, and are apparently destined to find wide and varied use. The lamps installed above may be fluorescent or incandescent—or, more likely, of both kinds employed in combinations to give varying color values and intensities in the exhibition space below.

Trough lights are surface-mounted fixtures, either open or with lens covers. With ordinary lenses the trough has to be tilted to direct the light, and sometimes the overhead rectangle of tilted troughs that collectively light the four walls of a room is built in by having the whole central part of the ceiling dropped a few inches to the level of the lower rims of the troughs. This arrangement has become common for lighting picture galleries, but it is now superseded by flush troffers with improved lenses that place the light to one side. Surface-mounted open troughs, which continue in use, are as a rule merely containers to screen their lamps from the eyes of visitors—the lamps being of the adjustable reflector type noted above as spotlights.

An experiment in lighting with *movable* open troughs has been made at the Museum of Modern Art, New York. Troughs of metal, in units 4½ and 9 feet long, are attached temporarily to the ceiling with toggle bolts, in positions called for by movable partitions. The troughs hold projector lamps, in adjustable sockets, for spotting objects individually. There are transverse baffles in the troughs, but these do not overcome the greatest difficulty with this scheme of lighting, which is that stray light glares in the face of the visitor as he passes through almost every doorway.

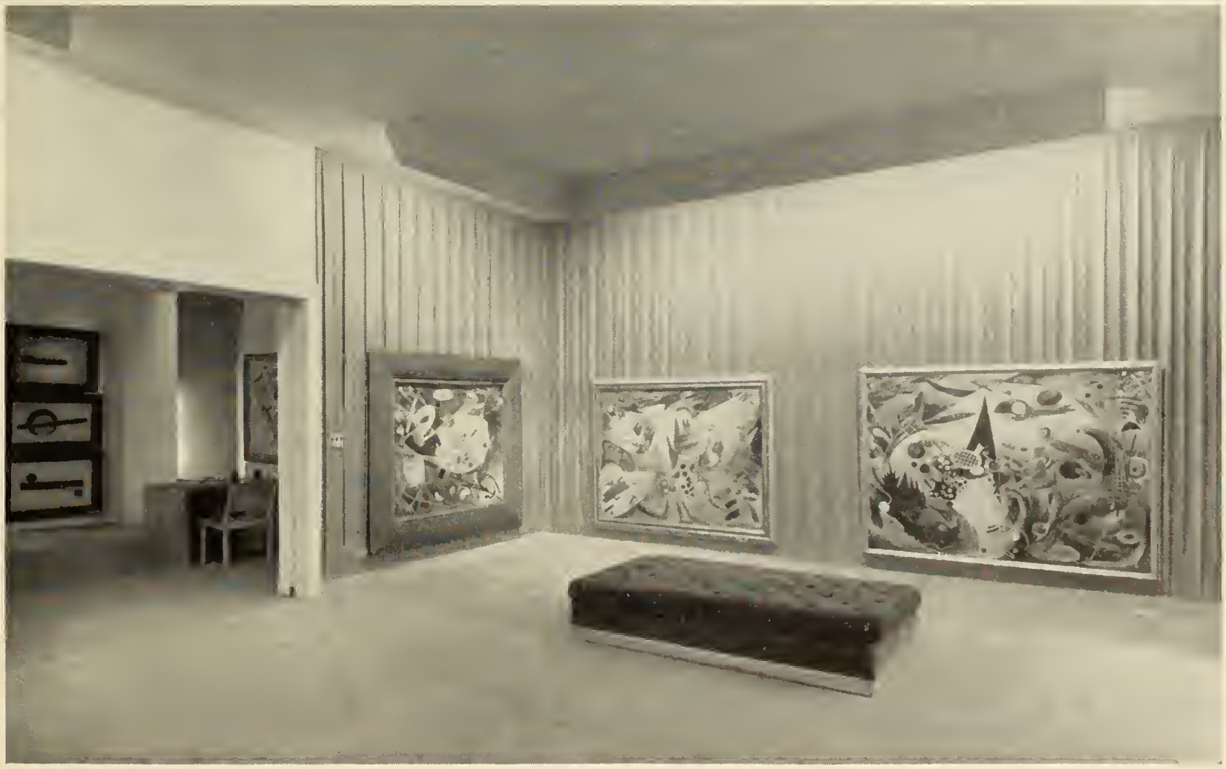


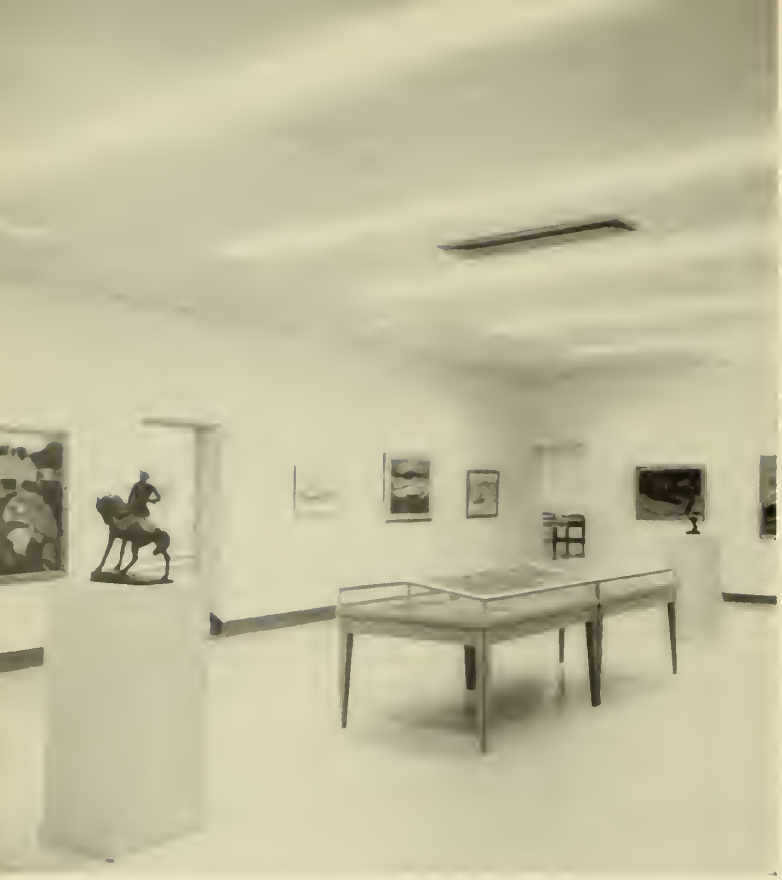
Courtesy Denver Art Museum

LOUVERED CEILING THROUGH WHICH COOL GENERAL ROOM LIGHT AND WARMER OBJECT SPOTS CAN PASS WITHOUT GLARE

FLUORESCENT TROUGH LIGHTS FOR OBJECTS AND, BY REFLECTION, FOR THE ROOM. WITHOUT ADDED WARMER SPOTS THIS IS A NEW FORM OF ALL-PURPOSE LIGHTING

Courtesy Guggenheim Museum of Non-Objective Painting





Courtesy Thomas Gilcrease Foundation, Tulsa

TROFFER LIGHTS FOR COOL ROOM LIGHTING, ADJUSTABLE SPOTS FOR WARMER OBJECT LIGHTING. NO DAYLIGHT TOKEN

However, trough lights, no matter how skillfully they may come to be installed, are exposed fixtures and seem destined to give place to troffer lights.

Troffer lights are panel luminaires that are set flush in the ceiling. For museum purposes they are now covered by special directive lenses that place light at an angle on the wall or elsewhere as desired. The troffer may contain separate lamps for general lighting and for spotting—perhaps fluorescent lamps to give cool room light and incandescent lamps to give warmer object light. The troffers may be in small box like units, distributed according to requirements of the exhibits, or they may be in long units, perhaps set end to end in ribbons; and for exhibits of pictures they may form an overhead rectangle as in the case of troughs. With "*Controlenses*," made by the Holophane Company of New York, rays may be focused, projected parallel, or spread, and the beam may be deflected away from useless and glare angles to points where the light is wanted. Set in an appropriate pattern these units can light a large area evenly—from two directions at each point if desired, to eliminate shadows and dark corners. They are not subject to overheating and consequent cracking of lenses if the lenses are of the right type and the troffers are of a size specified by fire underwriters.

The growing use of flush fixtures encourages the adoption of suspended, or hung, ceilings (page 137). This type of ceiling, by the way, is not to be confused with the ceiling that has a center panel dropped a few inches to take in slanting light troughs around its margin. The hung ceiling gives overhead space for ducts and other equipment as well as for wiring and inset lighting fixtures, and it may allow within limits for the ceiling height to be changed if so desired when a room is being remodeled. Flush fixtures ordinarily require from 13 to 15 inches of clearance above the hung ceiling into which they are recessed; but greater clearance is allowed as a rule since ventilating ducts need at least 18 inches from hung ceiling to structural beams. In fact, several feet of clearance may be left if the ceiling is regarded as a means for possible future adjusting of the height of the room below.

The use of troffers and opaque panels set in suspended ceilings of complete flexibility is a development that museums should not overlook. Some of the practical possibilities of this system are shown in a trade booklet *Ceilings Unlimited* obtainable from The Miller Company, Meriden, Connecticut.

Polarized light for direct illumination has been tried in a limited way, and it may find wider adoption with the development of polarizing glass for diffusing sashes, troffer panels, and perhaps directing lenses. The principal advantage is in reduction of glare and improved definition in seeing. One of the most promising uses of polarized light seems to be in lighting of exhibition cases. A polarizing glass, marketed under the trade name *Polaply*, is obtainable in several forms from the Polalite Corporation, Whitestone, L. I., New York.

Case lighting, which is a common form of direct object lighting, is discussed in connection with exhibition cases (page 237).

INDIRECT ARTIFICIAL LIGHTING is, in principle, general lighting—for rooms, not primarily for objects. And since the purpose of room lighting is to provide favorable conditions under which to carry out object lighting, an ever-present concern is the matter of brightness contrast. Luminaires that provide a general flux should not be too bright or too dull (see page 81) for separately lighted exhibits, nor should they lack sufficient brightness to take care of all parts of the room. Thus excessively lighted ceilings may set up glares of their own; whereas insufficiently lighted ceilings, such as are often noted under balconies, may allow other things to be glaring. By the same token it is rarely possible to light a room properly with only spill light from exhibits.

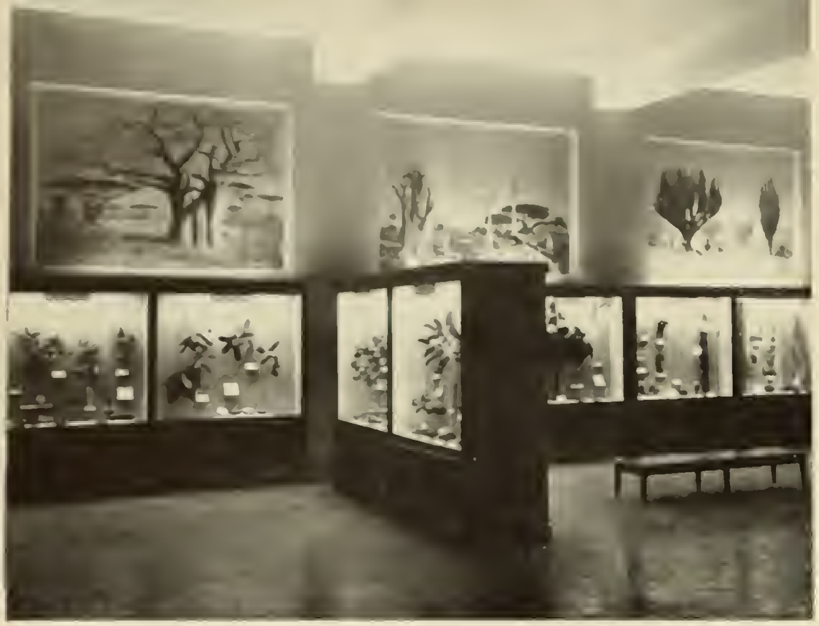
Along with the growth of indirect room lighting, there has come a marked effort to coordinate illuminating design with architectural design, instead of using a "tacked-on" system of lights. This development has already gone far toward eliminating suspended and projecting fixtures, and it promises in time to do away with them altogether. However, suspended fixtures of the kind discussed below cannot be passed over in this discussion.

Suspended fixtures of indirect and semi-indirect types, employing incandescent lamps, are in wide use. By directing light to the ceiling, these fixtures shield the eyes from source brightness. Unpleasant silhouetting of the fixtures against the lighted ceiling can be relieved by use of fixtures that reflect or transmit a small amount of light to the outside of the fixtures, making the enclosing parts softly self-luminous. For good utilization of the light generated, it is essential that ceilings have white or light-colored, diffusing finish. For uniformity of ceiling brightness, the suspension distance of fixtures should be at least one-sixth, preferably one-fourth, of the distance between fixtures. And since the suspension distance obviously has to be less under a low ceiling than under a high ceiling, the spacing of fixtures is closer in low rooms, and the wattage of lamps should be correspondingly less for a given level of illumination. Fluorescent lighting has certain advantages for rooms, as we have seen, but suspended fluorescent fixtures of indirect or semi-indirect types are only now being developed. Most fluorescent fixtures are of semi-direct types.

SUSPENDED INDIRECT FIXTURE OF TYPE THAT LETS SOME LIGHT THROUGH TO SOFTEN OWN SILHOUETTE

Courtesy Brooklyn Museum

Concealed uplights are used for flooding light to the ceiling from the tops of cases, screens, or other room appointments. The New York Historical Society shows some good examples in its lately remodeled rooms. Uplights in wall lambrequins are not satisfactory, if only because of the local bright spots they make. And portable uplights, or indirect floor lamps which are both in the way and easy to put out of place, are rarely used in exhibits, although they are sometimes seen in lobbies and elsewhere.

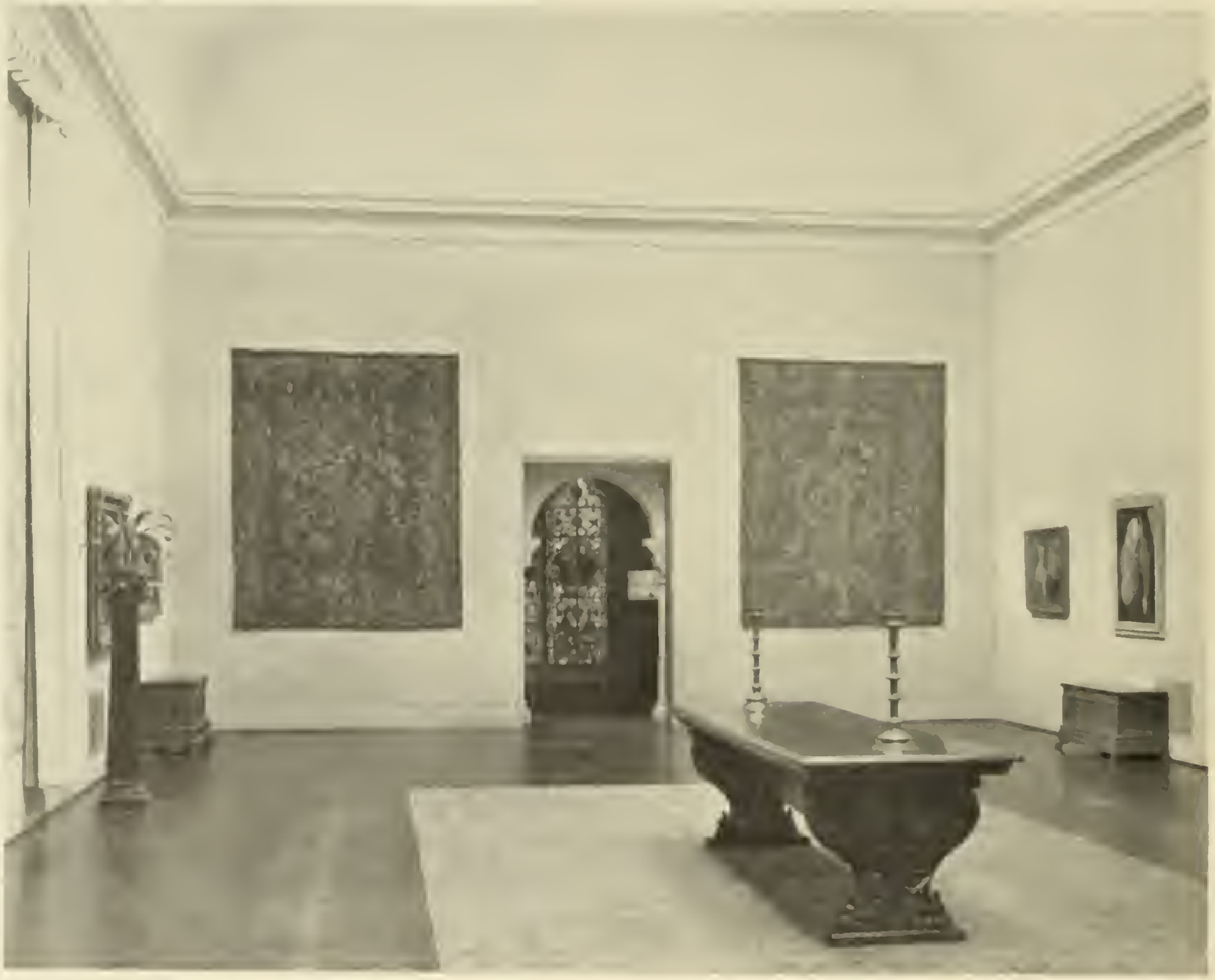


Courtesy Chicago Natural History Museum

UPLIGHTS PLACED IN TOPS OF CASES PROVIDE INDIRECT ROOM LIGHT OF ADJUSTABLE INTENSITY, ALSO SHOWING MURALS

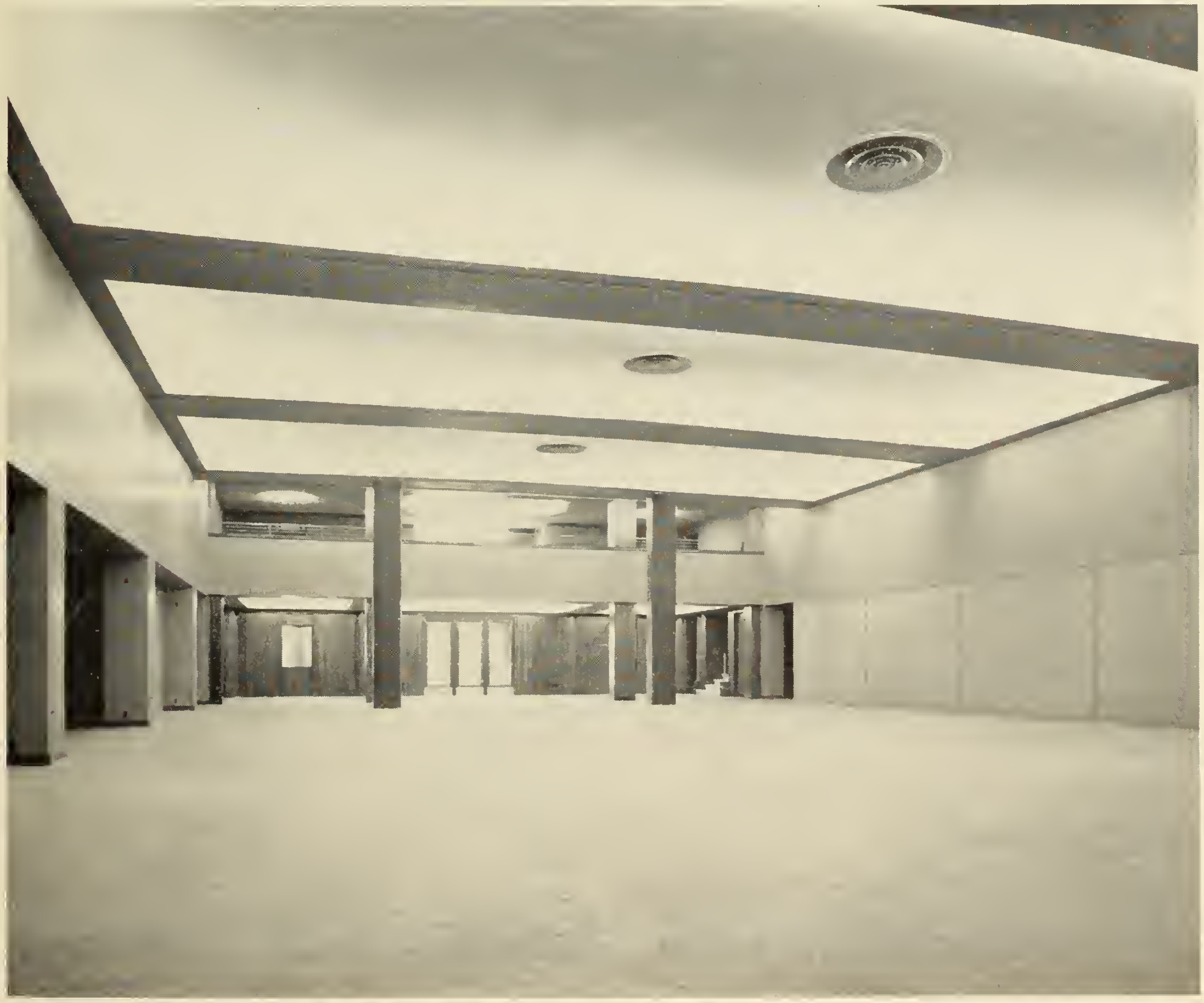
COVES HERE CONTRIBUTE TO LIGHTING OF GALLERY WITHOUT PROVIDING OBJECT LIGHTING FOR NIGHT

Courtesy Museum of Art, R. I. School of Design



Lighting coves, with ledges concealing light sources, are very effective means of indirect room lighting. The single ledge at the cornice has long been familiar; and this type is serviceable not only in rooms of moderate size but also in very large halls such as the naves of the great pavilions in Chicago's Museum of Science and Industry where the coves have hidden catwalks for servicing the lights. The usual cove, from wall ledge to ceiling, curves on a radius of four feet more or less depending upon the size of the room. However, rectangular corner construction can replace the traditional cove if the lighting installation is rightly designed. The light recess, in any case, should be dropped from the ceiling at least one-sixth the room width to give fairly uniform ceiling brightness. Recessed reflectors of white plaster, often used, illuminate the margin more than the middle of the ceiling; but polished metal reflectors, if properly aimed, can overcome this difficulty. With the advent

INDIRECT LIGHTING PANELS OVERHEAD PROVIDE COOL GENERAL LIGHT FOR THE ROOM
WARMER CASE LIGHTING WILL BE ADDED. TOKEN OF DAYLIGHT COMES FROM DOOR.
Courtesy Rochester Museum of Arts and Sciences



of modern style there have come multiple light ledges formed by overlapping layers of ceiling or wall. From such recesses light may be directed upward and inward, as from steps in a vaulted ceiling, or horizontally outward, as from steps in a flat ceiling. They are perhaps most familiar in auditoriums, where they open toward the stage. Cove lighting lends itself well to the use of either incandescent or fluorescent lamps.

Lighting panels, or shallow open coffers with light troughs concealed in their rims, offer many possibilities in form and use. Ceiling panels of this kind may be rectangular, circular, ribbon-like, or of free form. They may be large or small, and may be placed singly or in groups. The ceiling grids of small rectangular panels in several rooms of the Cranbrook Academy and the series of long rectangular panels above the main exhibition space of the Rochester Museum are examples. It is important to have panels correctly designed. Overbright margins, which are common sources of glare, are due to insufficient depth of panel and to the absence of metal reflectors. Incandescent lamps are used in some panels; but fluorescent lamps are much better and their use is increasing.

Vertical panels on *walls* are seen in some museums, but they are not very satisfactory because of the glare they set up from their low position. However, period rooms are often lighted indirectly through their windows by means of large vertical panels embracing lamps concealed outside the window frames. The success of this method traces to a combination of circumstances including the visitor's expectation of side light where there are windows and the fact that period rooms have diffusely reflecting surfaces for the most part.

CHAPTER VIII. ORGANIZATION OF SPACE

WITH NEW FREEDOM given by recent developments in engineering and architectural design, the museum planner can approach the problem of organizing space in a direct and practical way. No longer need one take for granted some conventional form such as Gilman's "standard museum arrangement" consisting of "exhibition space about two large areas separated by a structure containing the main entrance and stairways," (*Museum Ideals*, page 141), or any of the stereotyped developments of this pattern yielding trefoil, foursquare, U- and V-shaped, E-shaped, H-shaped, or other such formal ground plans. These shapes are all right if requirements of the museum point to them, but they are no longer indicated before the problem is worked out.

THE TYPE OF STRUCTURE, shaped to the size and nature of the terrain, should be an expression of the individual museum. The architect has opportunity to create a form, itself of interest, which will further museum purposes. There is no one modern type of museum. We shall see presently that buildings combining horizontal and vertical masses are likely to develop under some conditions; but this is without prejudice to low spreading buildings, high compact building, or buildings of any other types that circumstances prompt.

The natural approach to any problem is through determination of space requirements for the different functions, and choice of the position in the building where each will work best by itself and in relation to other functional spaces. The building committee, with its director or museum consultant, must arrive at needs in square feet of floor space and in storage capacities. But positions and relationships can be suggested by general experience as to entrances and exits, lines of the public's movement and of work flow in the building, and best uses of different stories or groups of stories.

As a practical means of studying arrangements, good use can often be made of the well known plastic method of modeling with shaped blocks, each block representing one of the needed elements of space. For this purpose, pieces of some easily worked material such as balsa wood are better than hard blocks, since workable material assists in making experiments and in following changes of ideas. Thus in three dimensions, supplementing sketches in two dimensions, spaces can be simplified and their relations adjusted while the aggregate of masses can be studied for composition in volume and silhouette. Buildings planned partly in this way show marked structural vigor. They tend to be visibly different from buildings planned wholly on paper.

Attention should be given from the start to requirements of the future and to ways of meeting them within the original scheme of space organization. We have already noted (page 16) the common mistake of vaguely projecting wings—often for the limited purpose of exhibition without reference even to related live storage. Modern style should be helpful in the matter of projecting extensions of space along lines of functional growth.

It is not realistic to plan for too long into the future, however. Museum buildings that by now have gone out of use have had an average life of less than 40 years. A few still in service have passed the 50-year mark, but most of these are about to be practically rebuilt—the American and Metropolitan museums among them—or (except for historical pieces like Peale's Museum in Baltimore, Pilgrim Hall at Plymouth, Philadelphia's Memorial Hall, and the old Smithsonian building) they are plainly destined to come down very soon. This is in keeping with library experience which now puts the life of a building at 50 years. Museum planners would seem to be justified on the whole in planning for about the same time of growth.

Before coming to particulars, two general ideas of space organization are worth noting. These are the radial and the segmental schemes of development. According to the first of these, the museum would have a central exhibition area containing displays designed for the general public, with radiating departmental areas for interested visitors to choose between, and study rooms communicating with curatorial storages at the periphery, for special workers. In *The Art Museum of Tomorrow* (*Architectural Record*, Jan., 1930) Clarence Stein diagrams this idea as a cartwheel with general exhibits at the hub, departmental exhibits along the spokes, and curatorial quarters with their storages around the rim. As a guide to the planner in relating lobby to spread-out exhibit spaces, and these in turn to curatorial suites, floors, or blocks, this scheme is fundamental; but no one should think that round museums are contemplated by those who suggest it.

The segmental scheme is that of organizing space in a series of articulated departmental units, to be put up one at a time or all together according to circumstances. Each unit would have both exhibits and curatorial quarters; and in a very large museum the units might be further developed to the point of being almost separate special museums. The Museum of Fine Arts, Boston, undertook to follow this plan in 1909 for its building having a central block, two corner pavilions, and a wing at the rear leading to lateral ranges (one still to be built) thus providing units for five departments; and the Metropolitan Museum now plans a remodeling that would give several almost self-sufficient units with separate entrances. This is plainly different from the familiar procedure of assembling two or three exhibition wings, a storage unit, an educational building, and another exhibition wing or two in the course of time. Some of the spirit of the segmental scheme can be seen in many a building.

The success of each building, as measured by experience of those who use it through the years, grows very largely from a few decisions of the building committee. Fundamental in this way is the matter of uses assigned to different levels from basement or sub-basement to top floor or perhaps penthouse; and just as important is the matter of entry and exit.

ENTRANCES AND EXITS have to be planned with regard to human frailty. In an honest and orderly world there could be a doorway wherever one would be useful. However, considering risk of theft, the safest arrangement for a public museum is to have only one entrance for the public and one for services, with the staff using either at will.

There may be—usually are—certain extra requirements which this very simple scheme does not take care of. Auditorium crowds should be kept from having the run of the building when exhibition rooms are closed to the general public. Children coming in numbers from schools, or one by one with their skates and bikes, have to be considered. And other parts of the museum's public, including art school students, may set problems of group management. Extra doors for all these uses would be too costly if properly supervised, and too hazardous if not; but at least one extra door is indicated as a rule.

The auditorium, whether or not accessible from the main lobby, requires an entrance of its own and may need separate checking and lounge facilities. A separate entrance makes the auditorium available for independent use at any time. And, as we shall see in Chapter XIII, another route to the lecture hall from the main lobby is highly advantageous.

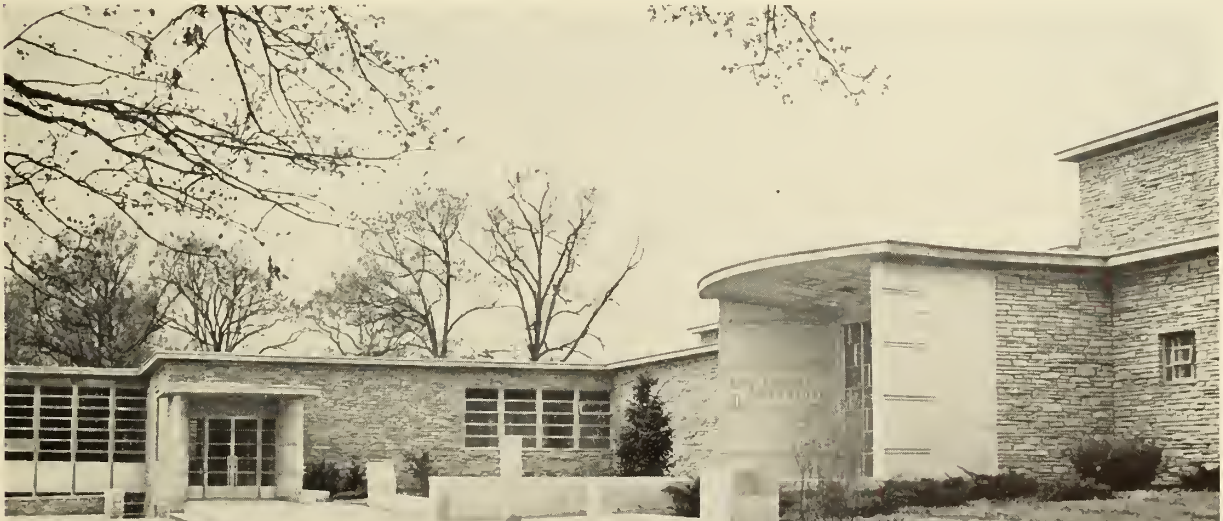
A separate entrance for children seems to have tactical disadvantages, besides giving a doorway that is hard to watch. As a rule the best arrangement is that of having a route from the museum lobby to the children's quarters (Chapter XIV).

For other special groups, including art students, teachers taking and returning classroom material, and employees, either the main entrance or the service entrance may suffice.

Extra *public* entrances, though not ordinarily desirable, are found in some buildings. The commonest arrangement prompting such an extra doorway is that of having a park approach with outside steps to the high main floor on one side of the building, and a street approach to the ground floor at sidewalk level on the other side. This scheme—devised for the National Museum building of 1911, and later adopted by several art museums following Cleveland's example of 1916—has serious disadvantages. It forces the placing of main exhibits at an upstairs level, reached from without by the least appropriate and least used entrance. Also it has an adverse effect on the functions of the first floor which ought to be used for the most important exhibits but has to be used in large part for some of the normal functions of the basement.

A few large museums have other multiple entrance arrangements. Some have two

PUBLIC ENTRANCE (RIGHT) AND STUDENT ENTRANCE OF THE DES MOINES ART CENTER. SAARINEN, SWANSON AND SAARINEN, AND BROOKS-BORG, ASSOCIATED ARCHITECTS



ground-floor entrances on opposite sides of the building. If the building is of very large expanse such an arrangement helps to make it accessible; but for this purpose there may be a useful suggestion in the projected Illinois State Museum, which will have an underpass from its rear parking lot to the main entrance in front. Also, there is the solution used in the Cranbrook Academy of Art which has a covered porch, approachable from either front or rear, between two separate blocks that are continuous in the basement. However, most museums need only one entrance for the general public.

Emergency exits, if required by law, must be guarded when subject to use and bolted securely at all other times. One-way fire locks are of little use since they guard against casual entrance, whereas casual exit is what museums need to prevent.

THE MAIN FLOOR, it is now generally agreed, should have the principal exhibition space. In many recent buildings this floor is at sidewalk level or not more than two or three steps above it—examples, the Museum of Modern Art, the Portland Art Museum, the Rochester Museum of Arts and Sciences, the Grand Rapids Public Museum, and, most notable of all, additions to several older buildings. The dropping of the main floor to sidewalk grade is linked with the advancing of the front of the building, and therefore of the main entrance, to the edge of the sidewalk.

Where the second floor, no matter what it is called, is the main exhibition floor, reached by outside steps or by inside steps and elevator, the ground floor has to be given over to purposes that can have only minor claims upon this best public space in the building. The type of building with a high main floor and outside steps is discredited by libraries as thoroughly as by museums. Old buildings having high, now unused, entrances and recently improvised basement portals are familiar evidence of the change that has taken place. The Brooklyn Museum's remodeling of the 1930's, which brought its main entrance to earth, stands as a conspicuous demonstration.

Steps to the main exhibits, whether they be outdoor or indoor steps, are not good, for several reasons. If placed outside the building, they may be hazardous in bad weather and are ever a barrier, especially to elderly and handicapped people. In fact, there are indications that even low outdoor steps will increasingly give place to ramps, as revealed by plans for several buildings soon to be started. If placed inside the building, even in the presence of elevators, steps to the main exhibits present a very real mental hazard, and they commonly take up too much space near the entrance. Half-flights, one up and one down, from a lobby at sidewalk level to the main floor above and a half-basement below, do not solve the problem. This plan fails to escape entirely what is bad in having main exhibitions upstairs, and it fails also to accomplish what is best in having the main floor at grade.

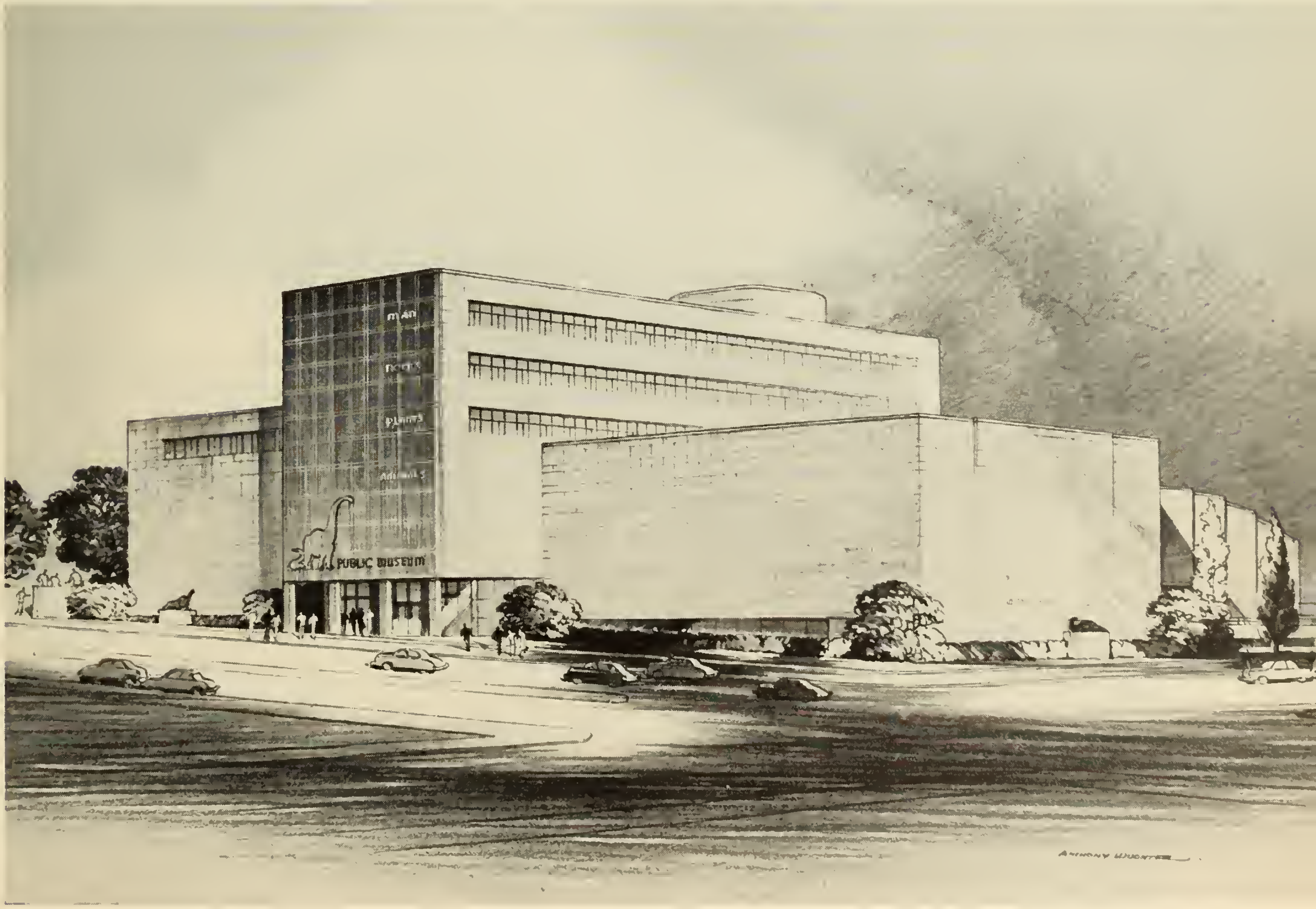
In view of all this it would be needless to comment on the scheme that puts the main exhibition space at the top of a building of several stories, were it not for the fact that this arrangement has been repeated several times since the State Historical Society of Wisconsin adopted it in 1900. If library functions of a state historical society must preempt the ground floor, it would be better to transfer museum functions to a separate state museum. And if a civic center museum must be above a town meeting hall, the museum had better not go to the civic center at all.

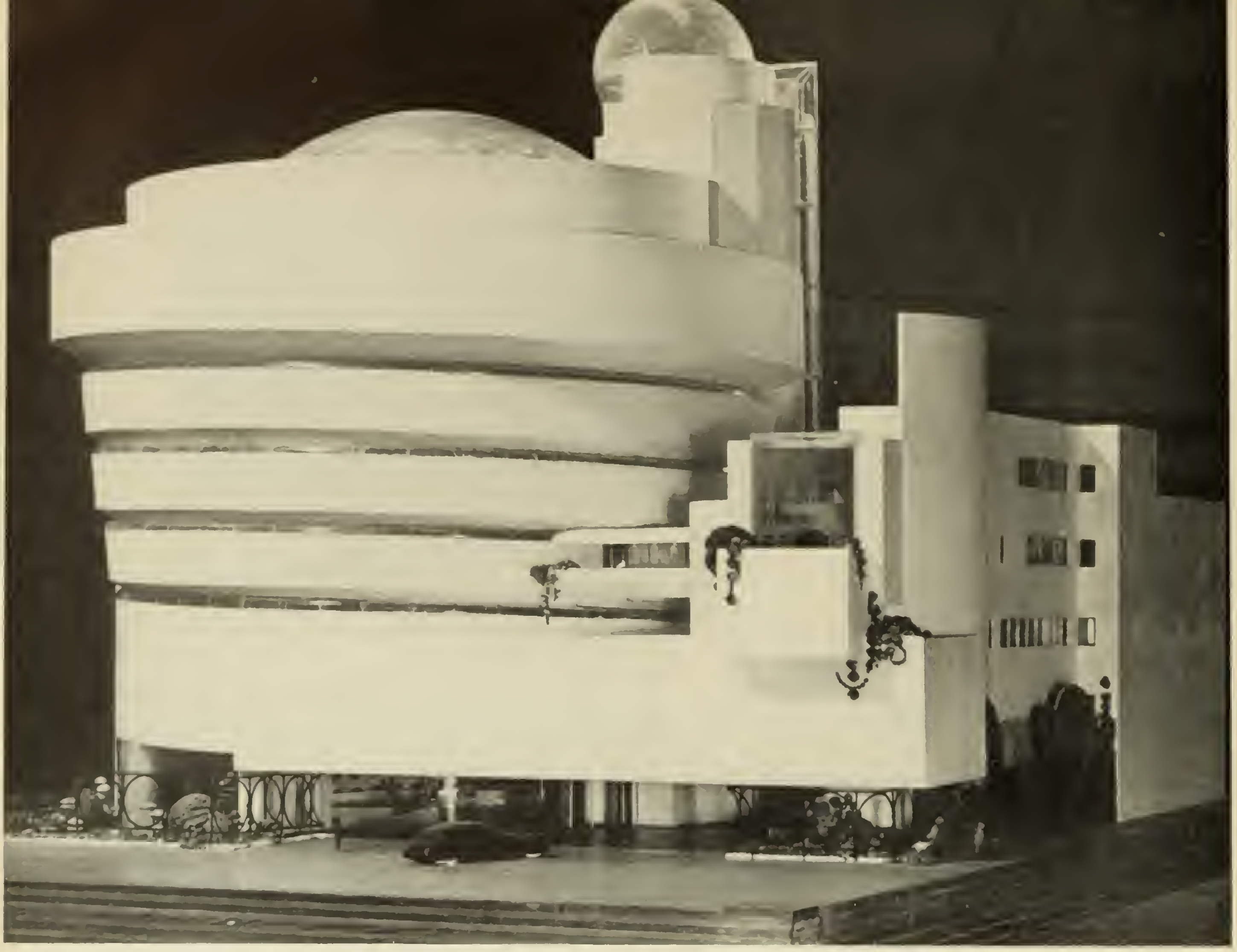
These injunctions are prompted by actual examples familiar to many.

The ground floor may have uses in addition to those of the lobby and main exhibition space. In a very small museum the office and perhaps curatorial space, the library, and even a classroom may have to be on this floor, so that the person in charge can watch over as much as possible. In larger buildings these same rooms are likely to be in the basement, as succeeding chapters point out; and curatorial space promises to develop in blocks of several floors over part of the ground plan (Chapter XV). Small museums often assign multiple functions to space, as where an exhibition area is used alternatively for lectures and class work; and this tends to generalize the plan in a way not often found in larger museums.

Some buildings, most of them rather small, are developed horizontally at one level only, or at one level with a few rooms above.

PROJECT FOR NEW BUILDING OF THE MILWAUKEE PUBLIC MUSEUM, WISCONSIN. PUBLIC ENTRANCE AT STREET LEVEL, EXHIBITS ON LOWER FLOORS, CURATORIAL SPACE AND WORKROOMS ON SEVERAL UPPER FLOORS, SERVICES IN BASEMENT, LECTURE ROOMS ENTERED AT REAR. ESCHWEILER AND ESCHWEILER, ARCHITECTS

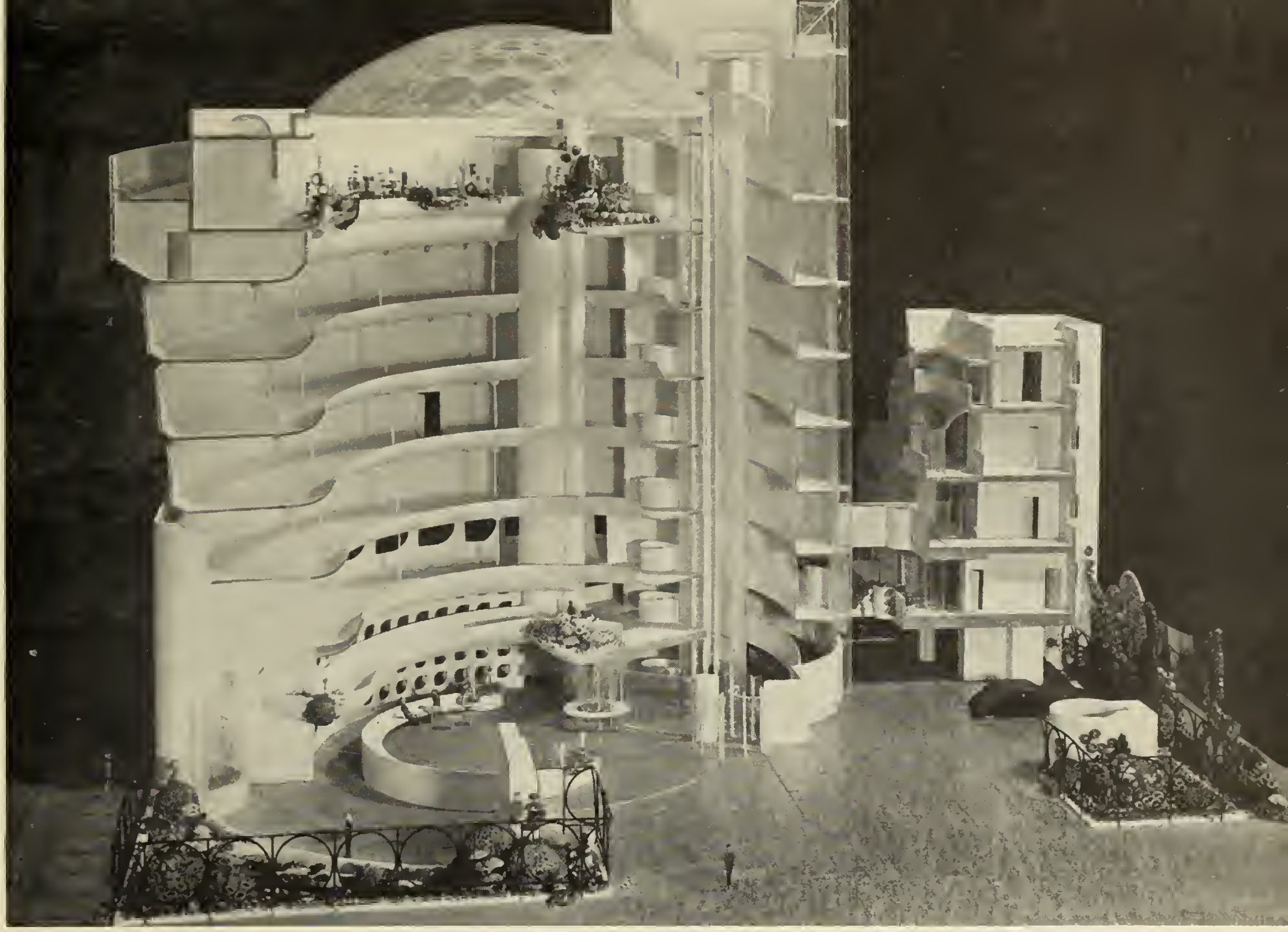




MODEL OF PROJECTED GUGGENHEIM MUSEUM OF NON-OBJECTIVE PAINTING, NEW YORK. PUBLIC ENTRANCE AT STREET LEVEL LEADING TO THREE-QUARTERS OF A MILE OF EXHIBITION GALLERY DESIGNED AS AN ASCENDING SPIRAL AND LIGHTED THROUGH A CONTINUOUS BAND OF DIFFRACTING GLASS. FRANK LLOYD WRIGHT, ARCHITECT

CHANGES OF LEVEL on an exhibition floor are a source of much difficulty. They may force the unloading and reloading of trucks when material is moved from one part of the building to another, and also they may be hazardous for the public. Each exhibition level should, insofar as possible, be in a continuous plane throughout its extent. This may be a point of contention between architect and building committee, because changes of level are sometimes helpful to the designer.

It has always been assumed that floor planes would be horizontal as well as continuous. But Architect Frank Lloyd Wright has designed a building for the Guggenheim Museum, New York, which will have the exhibition floor not level but ascending in a continuous spiral at a grade of seven inches in each 40 feet. This surely does not offer bodily hazards or obstacles to movement of things; and the grade may be, as predicted, quite unnoticeable. Anyone who has installed exhibits knows how, with vibration of the building, objects dance down the slightest incline of case shelves or other planes upon which they rest. However, the Wright conception is stimulating, and for a picture gallery it has certain advantages.



MODEL SHOWING INTERIOR OF GUGGENHEIM MUSEUM OF NON-OBJECTIVE PAINTING. EACH CIRCUIT OF SPIRAL EXHIBITION RAMP IS REACHED BY PLUNGER ELEVATORS. LEVELS ARE CONNECTED BY SINGLE TURNS OF FAST RAMP AROUND ELEVATOR SHAFT. CENTRAL SPACE ROOFED BY A GLASS DOME. FRANK LLOYD WRIGHT, ARCHITECT

THE SECOND FLOOR, one story above the ground, is the level that offers most questions. If it exists at all, its use depends upon adjustment between several demands.

Where exhibits require more space than the ground floor provides, exhibition space should extend to the second floor rather than to the basement. This arrangement lends itself to developments in exhibits, as noted below; and it is supported by the fact that the basement is usually overcrowded with other facilities which cannot be placed elsewhere. However, the second floor is less useful than the first for the principal exhibits. It is the floor for secondary exhibits, designed to serve students and other purposeful visitors. Reversal of this order, as in several of the older art museums, is a consequence not of bad logic but of a necessity produced by traditional design.

If exhibits are on the ground floor only, as they are in many buildings on ample sites, space above the ground floor is the natural place for the curatorial function with its need for taking care of expanding reserve collections. We shall see (Chapter XV) how modern conditions may favor this arrangement. Neglect of curatorial requirements, as has been noted and will be again, is a common and serious error of museum planners. Leaving this problem for the future to solve, without providing any way in which the future can take proper steps, is no solution at all.

Although exhibition and curatorial work are most likely to have space on the second floor, certain other functions may make claims at this level also. Part of the business office space may be here, perhaps at the front of the building above the reception desk on the ground floor (Chapter XVI). Administrative offices, together with curatorial offices perhaps, may form a vertical front block, giving a windowed façade, as in more than one museum. The library reading room too may be on the second floor. However, the reading room is part of a system including the stacks, and this unit may be organized in various solid forms with which Chapter XII is concerned.

The second floor is hardly the place for educational space because of the many other claims upon it and also because the second floor may be a little too far from the entrance level for its ready use by classes. The Rochester Museum gets around these difficulties by having its educational work on a mezzanine floor above the low-ceilinged perimeter of the main exhibition floor.

The suggestion has been made that there be mezzanines above certain ground-floor display rooms in order to provide curatorial space, with its study rooms leading to storages, in close proximity to related exhibits. Print balconies with study rooms give hints of this in several museums.

FLOORS ABOVE THE SECOND are no longer considered entirely suitable for exhibition, nor are they redeemed for this purpose by elevators. It is a matter of observation that a sizable part of the visiting public will not ascend to a third and fourth floor of exhibits. Science museums have sometime had as many as four floors of public space, with different branches of subject matter assigned to different levels; but this arrangement is hard on the upstairs departments. It is significant that the American Museum of Natural History once planned to remodel its building so that its old four floors of exhibits would be reduced to two.

Floors above the second, by the inescapable logic of congestion at lower levels, give the best place for study storage and curatorial work. The curatorial function, in a museum that has had any considerable time to grow, needs more space than it can get in the basement where it would be in competition with practically every other function except that of display. Not even a museum starting off empty can afford to disregard this problem. Study storage may well be arranged by departments of subject matter, each space being placed as close as possible to the related exhibition area. In a low and spreading building this tends to isolate curators at more or less separate points; but in a building with a high block of curatorial space above part of the exhibition area, there are simple ways of keeping curatorial offices close together and also near their related exhibits. Chapter XV returns to this subject.

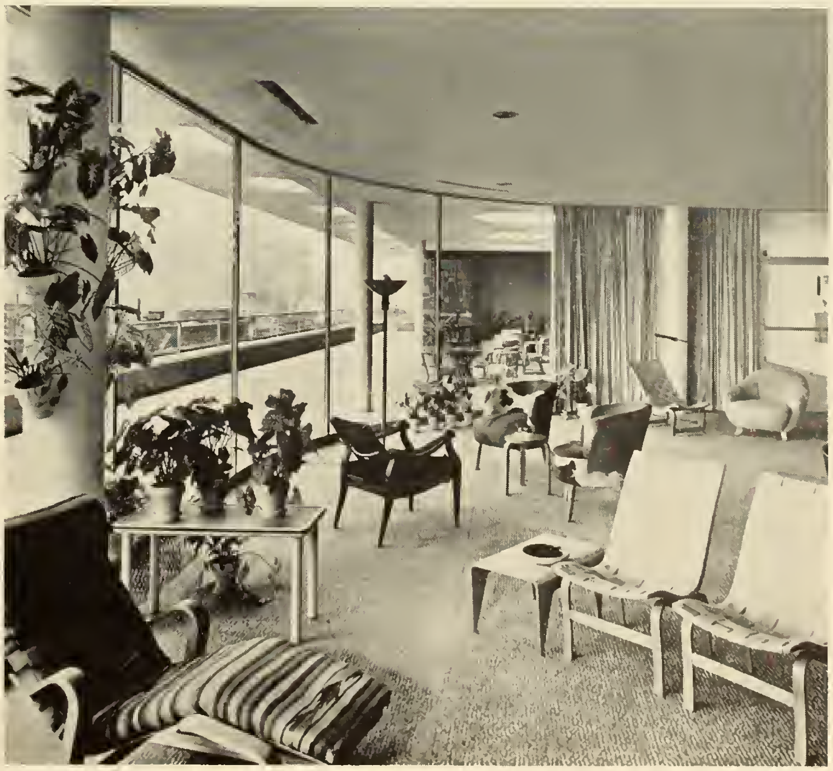
Multi-story museums have been proposed again and again, usually at the prompting of commercial buildings which have merchandising, banking, entertainment or other business for the public on lower floors, near ground level, and a tower of office space above. The same arrangement should be workable for museums, and sooner or later a museum will probably adopt it. But this does not necessarily mean a skyscraper type of building, since even a few floors of curatorial space above one or two large exhibition floors could give a space organization of very advanced type. A centrally located museum with no immediate use for all the space a tower would provide could rent upper floors and later recapture them for curatorial purposes as the collections grew.

THE ROOF is a relatively unused place, but it has some alluring possibilities for museums. In the older buildings this was not a natural development, partly because of skylights and partly because roof terraces giving off enclosed spaces were not much known until the advent of modern style.

In a building of one story, the roof or some part of it is within range of use for exhibition. Art museums might show small sculptures and science museums could have living plants and animals here—if the roof were designed for the purpose. In a building of two stories

Functions other than those of storage and study sometimes have a natural place above exhibition levels. The library stacks may rise as a shaft, or pile of shallow spaces. And administrative offices have been placed at one or more upstairs levels.

similar arrangements might be made for the use of a setback at the second floor. An outdoor part of the library's reading room, reached from an indoor reading room at the same level, already realized in Philadelphia's Free Library, would be a delightful venture for a museum. Higher buildings might have useful roof decks at upper levels. The Rochester Museum has a third-floor roof deck used at times as an observatory by a star-gazers' club. The Museum of Modern Art has an airy, sixth-floor members' lounge and restaurant, partly enclosed and partly on a roof terrace.



SIXTH FLOOR MEMBERS' ROOM AND ROOF DECK. MUSEUM OF MODERN ART, NEW YORK. PHILIP L. GOODWIN, ARCHITECT, EDWARD D. STONE, ASSOCIATE

THE BASEMENT, which is a story at least partly underground, is treated almost as the ground floor in many a high-set museum of the past. But the disappearance of outside steps as the main floor comes to grade has put the modern basement largely below curb level. However, this need not mean a dark lower story. The basement windows may have lighting wells; and where land falls away, the rear of the basement may be in the open. The Worcester Art Museum has a continuous lateral moat 15 feet wide and as deep as the basement; and this seems better than several small areas, one for each window, since small areas catch trash or if covered with a grating do not give enough light. A moat should have a door leading to it for use in cleaning.

The basement is the most congested part of the museum as a rule; into this story, time and again, has been crowded everything except the main exhibits. In skylighted museums this has been so because no upper floors could be provided for curatorial and administrative functions. Familiar to every museum worker is the basement with dark and inadequate storage space, an auditorium, a restaurant, secondary exhibition spaces, quarters for educational work, the library, offices, various shops and perhaps a photographer's laboratory, receiving and packing rooms, registration and temporary storage places, locker rooms, and showers, toilets for staff and the public, to say nothing of the entire mechanical plant. However large the basement floor may be, it cannot be large enough to provide, except perhaps at the very start of a museum's career, for all these facilities developed as they should be in relation to the size of the museum. The basement is commonly an overcrowded hole from which departments of work have been known to move to skylight attics or commandeered galleries.

The basement, primarily, is the superintendent's floor. Its natural functions are those of the services and the mechanical plants, considered elsewhere.

The service entrance is the key to the use of this floor, and it must be easy to reach by motor truck. An approaching ramp is required if the site does not give a level approach to the basement at some point where the service entrance can be placed, usually at one side or the rear. No matter how land lies, to be right for a museum it must allow a natural or engineering solution of this entrance problem.

The services have to do with movement of supplies and museum materials from the service entrance through the museum's channels of work. The most characteristic service is that of receiving and dispatching many objects to and from the collections and exhibits. This work calls for unloading and loading, unpacking and packing, temporary storage of both containers and their contents, registration and perhaps treatment for infection or damage, more or less photographing, and transportation within the museum—as much of this as possible to be in the basement. Equally demanding of basement space are the shops, which must get their materials easily from the receiving entrance. And since the basement is the home ground of the mechanics and laborers, it is also the only good place for lockers, shower, and rest rooms for these members of the force, for whom a lunchroom may also be needed.

The mechanical plant, with an equally strong claim upon basement space, may be placed half a story lower or at sub-basement level. However, part of the plant may be on the roof, as noted elsewhere.

Besides these practically inevitable assignments to the basement level, there are other possibilities. The auditorium is very often placed in the basement. Educational quarters—classrooms, the lending collection's lodgings, and kindred spaces, for which see Chapters XIII and XIV—may be placed here also, to make them easy of access; but the possibility of having an educational mezzanine has also been pointed out.

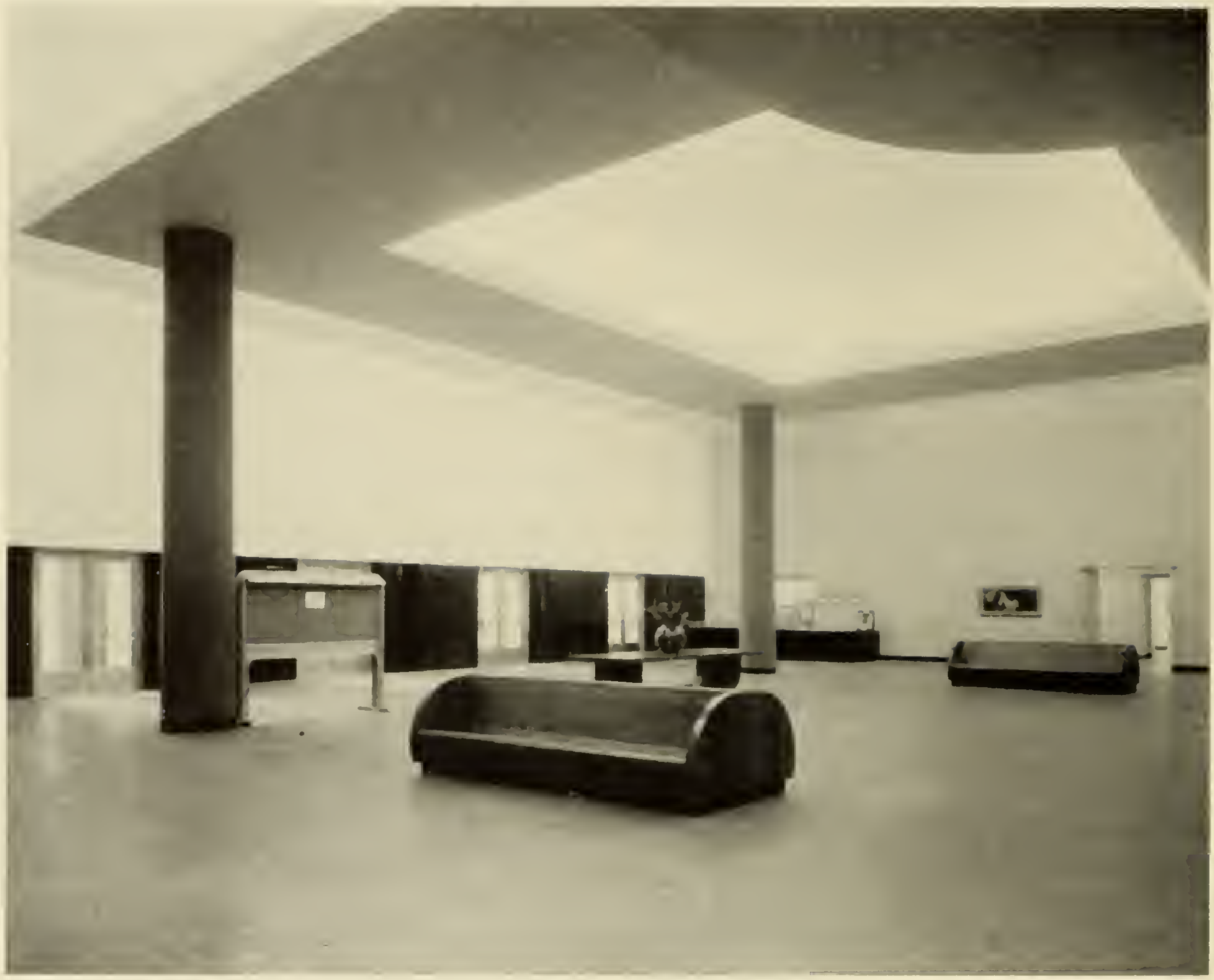
Several rooms which are commonly in the basement are, as a rule, much better placed elsewhere. The library reading room is one of these, calling perhaps for a place on the second floor, or on the main floor with the principal exhibits. Offices, as we have seen, also tend to go aloft. And the restaurant, which remains to be discussed, may go too.

Finally, there are functions that should *not* be carried on in the basement, no matter how commonly they may have been so assigned in the past. These are the work of the curator, and, as already noted, exhibition. To begin by putting the nucleus of curatorial storage in the basement is like committing the museum to a choice between an eventual stalemate and extending under ground either downward or beyond the plan of the building. All too familiar is the basement storage room which starts the museum on a course with its dead end plainly in sight. Nothing but blind copying can perpetuate the mistake.

BELOW THE BASEMENT, in a very few museums, are services that ordinarily the basement or floors above would have. On a small city plot, deep excavation may be as much in order as high construction. In New York, the Frick Collection went down a distance of 45 feet, mostly in bedrock, to give several levels of required storage space.

There are several buildings in which sub-basement stories are the result of very sharply sloping ground. The Museum of Art of the Rhode Island School of Design, with a one-story façade, has actually three lower levels, with windows looking out at the rear; and this takes care not only of the services, but also of study storage in what amounts to a block, or "tower" extending downward instead of upward. Such an arrangement, however good it may be in the exceptional case, points again to the solution which gives a rising block of curatorial space above at least part of the ground plan.

Since it may cost a great deal more to make a story underground than to build a story above, the sub-basement is no stolen march toward economy. On many a site the sub-basement can be held against ground water only by regular pumping and all too frequent repair. Even at best the sub-basement in a level site is a hole to which parts of the physical plant, but little else, can decently be assigned.



LOBBY OF BROOKLYN MUSEUM, NEW YORK. A NEW INTERIOR AT STREET LEVEL

CHAPTER IX. LOBBY AND ADJUNCTS

Good management of visitors in a public museum requires a well arranged lobby. Care should be given to planning this space as well as certain rooms connected with it.

The vestibule, or anteroom of the lobby, is a kind of weather trap. It should be planned with the care it deserves as the place of the visitor's first experience with the museum. A less-than-adequate vestibule means, among other things, a certain abuse of the lobby, especially in bad weather. We have already noted that the outer doors should be near the sidewalk, both vertically and horizontally. Recent buildings tend to have them so, in contrast to the older buildings which were mostly set back on their sites and commonly had high flights of approaching steps.

For the convenience of people coming in cars there may well be an extending roof slab at the entrance, and this should be completely drained in some other way than down the collars of alighting visitors. To meet the convenience of an attending special crowd, an extension of the shelter may be needed. For this, a canopy that extends along the curb is better than the kind that meets only one car at a time.

The vestibule itself should be designed to afford protection from wet and cold when people are waiting for the museum to open. Some large buildings have enough vestibule space to take care of a school class or two before the opening hour. Instead of a vestibule of any really useful size, an open portico or space in a hollowed front has often been provided, but an exposed place is not satisfactory in most climates. The entry may need artificial lighting.

The doors, outer and inner, are now of glass as a rule, and the outer doors may have bronze or other metal exterior grilles. This arrangement affords a preview of the lobby. The solid bronze doors of so many of the earlier buildings were unwieldy and forbidding. Front doors should open freely outward; they should be hung lightly enough so that women and children can open them even against wind pressure; and they should have automatic closing devices. The total width of all doors leading to the vestibule, and again of those inside, should be sufficient to take care of conditions during maximum occupancy of the building. Revolving doors, though helpful where there is no protected vestibule, and though apparently satisfactory if a doorman is in attendance, are generally in disfavor. Boys enjoy revolving doors far too much, whereas elderly and handicapped people find them hard to operate. Libraries too have mostly abandoned the use of revolving doors, and many libraries as well as museums have separate sets of swinging doors for passing in and out.

In the projected Guggenheim Museum, New York, there is to be a suction mat at the entrance to clean loose dirt from the shoes and clothes of visitors without consulting them.

The lobby is the control room in any museum large enough to have space organization of other than the simplest kind. Little museums may get along without lobby space of special character, but a museum of considerable size should have its lobby arranged for effective supervision of public parts of the building by the minimum number of museum people. Bad planning of the movement of visitors at this point is a common source of administrative difficulty and constant maintenance cost, to say nothing of the public's confusion.

Visitors are usually counted as they enter. For this purpose some museums have turnstiles, a few have an electric-eye device, but most prefer a tally register in the hands of the doorman. No method of counting yet devised gives really significant figures, since what is needed is a breakdown of attendance by the purpose of the visit—whether to see exhibits, to attend a lecture or some group activity, to take school instruction as a member of a class, to borrow from the lending collection, to pay a business or professional call, or just to earn one's living (which has been known to score two or more visits a day for each member of the staff). This seems to call for something which has never been tried, namely, counting at several points leading from a well planned lobby to different parts of the building.

The position of the bottleneck where the count is taken at present is sometimes near the vestibule, sometimes at the back of the lobby. The latter arrangement seems much the better, especially if there are mechanical barriers, since it does not risk blocking the entrance. Turnstiles, if any, should operate in both directions for emergency exit, and there should also be a free path for getting out.

A box office is not required at the main entrance as a rule, the general admission charge for the public being almost a thing of the past. However if fees must be collected, the place for the cashier is necessarily outside the turnstiles or other counters. Among the few museums making a charge are several in which tickets are sold in the lobby and collected as the visitor passes into the museum proper, and again this is better than congesting the vestibule or the front of the lobby with these operations.

The lobby should be spacious, attractive, well lighted, and well ventilated. It should not be encumbered with architectural or memorial features. It should provide space enough for incoming crowds according to the size of the institution, and there should be seats for numbers of people at a time. The function of receiving visitors cannot be discharged properly by free space deeper in the arrangement of a building.

The check room and the information desk, are two ever-present features of the lobby. The latter often serves also as a sales place for publications and postcards. In small museums the three services of checking, information, and sales are performed as a rule by one person. In slightly larger museums there are separate attendants for checking and information—perhaps a checking guard who may serve also as doorman, and a young woman at the information and sales desk. In a still larger building the several tasks may be divided between one or more doormen, a checking attendant, an information clerk, and a sales person, with helpers as required.

The check room is usually at the right of the entrance, fairly close to the doors but not so near that a waiting line might sometimes block the way. The checking counter should be long enough for several people at once if use is active, although a small check room may perhaps have only a door, conveniently a divided door with a shelf at the top of the lower part.

For a building of any given occupancy, the required checking capacity naturally varies according to climate as well as by season and the weather of the moment. On an inclement winter day in a northeastern city, half of the visitors may want to check outer garments; whereas in some southwestern places not one visitor in 200 seems likely ever to call for a checking hook, and the doorman's worst troubles are cameras, sticks, and babies. For museums in most places the ordinary capacity (in hooks, with corresponding places for hats, packages and umbrellas) might be for one-fifth of the daily attendance; this could take care of one-third to one-half the people in the building at any time, since most hooks are used repeatedly in the course of a day. For extraordinary peaks of demand, as on special evenings, there should be extra space to bring the capacity up to the maximum probable attendance. For this purpose the check room should have an annex, which may well be given some other normal use. Thus in several museums the checking space overflows to a storeroom or office behind the check room, and in others it can further invade a corridor which is arranged to be blocked off on special occasions. The check room may also have space for a couple of lendable wheel chairs and ever for a few perambulators.

The information desk is usually placed at the left of the main entrance. Here the business caller asks about his appointment, the visiting group leader finds out what to do, the special worker gets his start to the right curatorial quarter, and the general visitor asks some of the questions that only he can think of. Not far off should be the stairway and passenger elevator and the starting point for exhibits. The function of selling publications and postcards, often carried on at the information desk, is discussed separately below.

The character of the information desk depends upon the size of the building. In a large museum there is usually an open counter, sometimes flanking the door to a room that serves as a reception place. In a smaller museum the desk may look out openly from an office in this position.

The business of the information desk can be simplified by having a bulletin board with a directory and a calendar of events. And there should be a floor plan of the building on view nearby, as elsewhere at various points.

Courtesy Cranbrook Institute of Science

LOBBY INFORMATION DESK OF SMALL SCIENCE MUSEUM CONTROLS STAIRWAY TO OFFICES AND CURATORIAL ROOMS ABOVE

Passenger elevators are important conveniences, if not necessities. Ordinarily, to be sure, more than half the museum's attendance will walk up one story in spite of a chance to ride; but a great many people prefer to wait and crowd into an elevator. More than two levels of exhibits are not desirable for many reasons; but apart from how many floors may have to be reached, elevator service for the public is considered necessary where say hundreds of visitors on any day of the week are expected to go above the main floor of the museum. A considered opinion about this has been recorded for libraries: "Cities of over 200,000, and cities which have more than 300 or 400 readers daily on upper floors, not counting newspaper readers and loafers, should equip new buildings with one modern elevator for present and future needs." (Wheeler and Githens, page 88.)

The number of elevators required will depend upon occupancy conditions. Most large museums have two passenger elevators operated by attendants, whereas smaller museums have only one, with or without an attendant. A very small museum with few visitors, may find the freight elevator sufficient if it is available for emergency passenger use. Notes on operation will be found in another chapter (page 228).

A special transport problem, that any museum may feel but that only a museum with a very large building can meet, is moving groups of school children up and down by elevator. The American Museum of Natural History, New York, has a class elevator of huge capacity in its school-service building. Some museums use the freight elevator for this. But if such traffic is moved up or down from the lobby, a wide stairway is indicated.

A separate small elevator, or even several of them, may be required for the staff in a large museum. This problem does not attach to the lobby, where the public and the staff can be served together.

The principal stairway takes off at best from the lobby within view of the desk. It has no claim on axial space, but should be in a convenient secondary position.

There are some further notes on stairway placement and staircase construction in another chapter (page 227), where also there are notes on ramps and escalators.

Control of offices is an important function of the lobby; arrangements should facilitate the exercise of this function from the information desk. The business caller ought to state his business immediately upon entering, not after going to some part of the building to which the doorman must send him. If the caller proceeds to an administrative office, his route should show good relationship of offices to lobby (Chapter XVI). Where there are two or more floors, the route is ordinarily by way of an elevator or stairway near the information desk to offices on another floor. Under no circumstances should offices have a separate private entrance from the outside, although nothing should prevent a member of the staff from coming and going by way of the building's service entrance if he so desires.

Control of educational space, in particular of classrooms, meeting rooms, the auditorium, and the quarters of the lending collection, is another important lobby function. Although the traffic to these busy places is normally relieved at times by a separate special entrance, some of the traffic has to be separated in the lobby from the stream of general visitors. The attendant at the information desk should be able to point to a passage or stairway near at hand. An elevator helps if another floor is involved, but there must be a stairway if school classes take this route. Classrooms and other rooms used regularly by children are usually downstairs from the lobby (Chapters XIII and XIV). However, as already noted, Rochester has an educational mezzanine between the first and second floors.

Control of the auditorium is partly independent of any route through the lobby, since the auditorium requires a direct entrance route of its own; but at best there is the suggested alternative route from the main museum entrance by way of the lobby, and this line of travel should be direct rather than through exhibition rooms. Where the auditorium is below the main floor, a stairway from the lobby is indicated. Where it is on the main floor, sharing this level with the principal exhibits, a direct passage from the lobby gives the best arrangement.

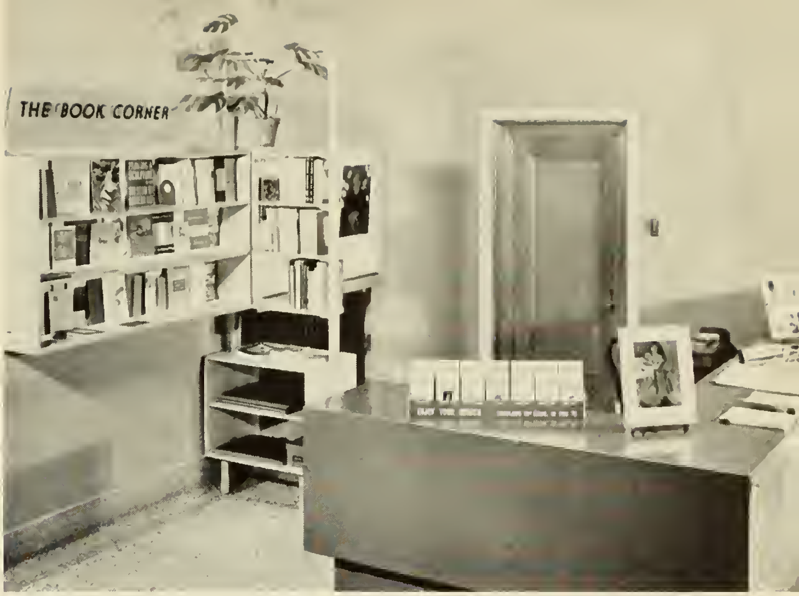
Problems of traffic to a main floor auditorium make the placement of this room a matter of prime importance. An auditorium that lies straight ahead of the visitor as he enters the building is as awkward as it is familiar. In museums with this plan there is double difficulty: lecture audiences have access to exhibits unless there are gates for use when exhibition rooms are to be closed; and the movement of the general public is interfered with by lecture traffic the latter often made up of noisy and crowding children. These considerations and others lead to the familiar suggestion that the auditorium be at the right or left as one enters the museum. Control of the route from the main entrance can then be exercised effectively from the information desk in the lobby.

The separate lobby of the auditorium is discussed in Chapter XIII; but a common effect of this extra lobby upon the main lobby is worth noting here. Allocation of the only public toilet rooms to the auditorium position sometimes leaves the main lobby without these necessary adjuncts. In a very large building there may be duplication, but ordinarily a scheme that makes one set of rooms available equally to both entrances is most satisfactory.

Control of exhibition space begins in the lobby, where the purposeful visitor gets his bearings and the aimless visitor sets out to do the building in one way or another. The work of the information desk and the plan of the lobby have their shares, active and passive, in this preparation; but a more deliberate kind of orientation is beginning to shape the lobby and space beyond it for the presentation of the museum to its visitors, as we shall see presently.

Control of the library and of curatorial rooms, which places are also served by the information desk through giving of directions, can best be considered separately (Chapters XII and XV).

Public telephones should be provided for the use of visitors—a house phone at the information desk, and telephone booths nearby in the lobby for outside calls. It is important to make some tasteful arrangement of built-in booths in order to keep the lobby from later being marred in appearance by having unsightly standard booths put in by the telephone company.



Courtesy Walker Art Center, Minneapolis

INFORMATION AND SALES DESK OF SMALL MUSEUM DEVELOPED AS BOOK SHOP AND ORIENTATION CENTER FOR VISITING PUBLIC

The sales counter, at which publications, postcards, and sometimes prints and other reproductions may be purchased by visitors, is very active in many museums. Most small museums do their selling at the information desk, but some large museums have the sales job differentiated to the point of featuring a separate little bookshop. Selling of this kind is a growing function; some of the Indian museums in the Southwest encourage native arts and crafts by marketing Indian products, and this is a practice worthy of being extended. A few badly run museums make the mistake of offering mere souvenirs and other unsuitable stuff; but, properly conducted, the business of selling is useful.

The separate sales desk, or shop, belongs in the lobby or in a space *openly* connected with the lobby. If there is a waiting alcove, over which the information desk presides, the sales counter might be related to it in the form of an angle with one leg in the lobby and the other in the alcove. If postcards are sold, there should be space for a writing table. The mistake should not be repeated of trying to conduct this work within a general business office entered from the lobby.

The sales counter itself requires a display top for books and prints, and there should be wall space nearby for further display. The necessary storage closet for stock is best placed behind the sales desk.

Courtesy Baltimore Museum of Art

MEMBERS' ROOM WITH LIGHTING FOR DISPLAY AND ARRANGEMENTS THAT GIVE SOME BENEFITS OF AN ORIENTATION PLACE

Introductory exhibits—not regular temporary shows or synoptic exhibits but timely small offerings intended as *hors d'oeuvre* in a sense—are commonly seen in the lobby. The familiar "object of the week" is appropriately shown here; and any necessary precautions should be taken for its safety. At times there may be something of seasonal or news interest or objects calling attention to the museum's current temporary exhibition. For such purposes there should be an allowance of lobby wall and floor space, preferably ahead of the visitor as he enters, but not where it blocks a vista or a traffic lane. The arrangement and wall treatment should be such that when the space is not in use it will not appear conspicuously empty.

Lighting of the lobby is ordinarily by mixed light in the daytime. The amount of natural light that gets in depends upon whether the lobby is fronted with glass for visibility from the street or has only doors and adjacent panels of glass to let in a token of daylight. Here, too, artificial lighting should follow principles of exhibition lighting, there being indirect cool light for general illumination and direct warmer light for displays and for the information and sales desks.

THE MEMBERS' ROOM is by its nature an adjunct of the lobby. Its origin as a kind of club room has tended to keep it in some more remote position; and now another possible reason for having this room elsewhere than near the entrance seems to be suggested by a sundeck lounge known as a members' room at the Museum of Modern Art. However, as a rule the best place for the members' room is off the lobby; and the best policy for it there is to have it open to anyone interested rather than strictly reserved for people already with membership cards.

TOILET ROOMS are required in number and size proportionate to the size of the building. Some very small public museums can have only a single rest room, regarded as a staff room to which visitors may have access by asking for the key. However, most buildings have at least four rooms, two for the public and two for the staff. Separate washrooms for children are very useful in a consolidated educational space.

The public rooms seem best placed in the basement, down stairs from the lobby and if possible connected also with the auditorium lobby in such a way that the room can serve the general visiting public and lecture audiences, either simultaneously or alternatively. Such double use of rest rooms, by its saving of space, tends to simplify the problem of having an adequate smoking lounge. Sometimes a position at ground level is indicated for rest rooms by other arrangements, but in any case the rooms should be well within the institution and under control of the lobby, rather than too near the front entrance where they can be readily patronized by the non-visiting public. On the other hand they should not be so far from the lobby that the doorman has to resort to pantomine in directing visitors. Toilet rooms which give directly onto exhibition rooms, or onto the auditorium or even its rear promenade, are not very satisfactory. It should go without saying that a basement public comfort station accessible only from the outside is worse than useless to the institution.

Several museums have toilet rooms at stairway landings, so that the two rooms are a story apart in the same position; one museum has its four rooms (for public and staff) on four staircase landings from halfway to the basement to halfway between the second and third floors. Mechanically this is good, but such schemes tend to be confusing to visitors and are not recommended.

Details of arrangement should not be neglected in planning these facilities. Where the two public rooms are placed near together, which is good for reasons of plumbing, the doors should be separated as much as possible. There may be simple ways of placing the doors on opposite sides of a unit, perhaps separated by a wall angle, perhaps even on different corridors. If there is a choice between turning right or left, the men had better turn right; and if one of the doors must be passed by everyone, it seems to be better to have this the women's door.

Equipment should be standard. In museums, as elsewhere, toilet and washroom installations have to be strongly put together since people will break off handles and steal soap dispensers, even knock over partitions. Boys will climb from one enclosure to another and swing on rods and braces. But the men's room is not the only one requiring heavy fixtures and stout construction. Forced ventilation should always be provided.

Courtesy Chicago Natural History Museum

MODERN CAFETERIA BELOW MAIN EXHIBITION FLOOR APPOINTED TO SERVE LARGE VISITING PUBLIC AND THE STAFF

Staff rest rooms should be near the offices; and additional wash bowls placed directly in workrooms save much time. Couches and chairs are usually required, and there should be a first-aid cabinet as well as some arrangement for taking care of an occasional visitor, here if not in or near the public rest rooms. In a great museum there may be as many as 10 people a day needing treatment.

Toilet rooms with showers, locker rooms, and other kindred facilities for museum artisans and laborers are provided in large museums. To simplify plumbing problems these rooms may be placed near the public rest rooms, but in such a way that the nearness is not apparent to anyone in the building. The rooms for the force are controlled by the superintendent's entrance, for which see Chapter XVII.

EATING ARRANGEMENTS in a large museum may include a kitchen and public dining room (more likely a cafeteria) and special provision for employees. In the typical small museum there is a single kitchenette for the use of the staff and occasionally of outside groups. Arrangements of some kind for serving food are found in almost every active museum, small or large. At one little institution where the building committee forgot, "the ladies were much put out."

There is always a question in planning as to how large an eating place the particular circumstances call for. This does not depend wholly upon the size of the building; in two great Washington museums, close together, the newer has a modern cafeteria serving between 900 and 1,000 persons daily on the average, whereas the older has never been able to keep even a small public lunchroom going. Efforts to draw in luncheon trade from park or street to make a museum eating place pay its way have been abandoned in several cities as not sufficiently rewarding. Some large museums with kitchens and sizable dining rooms, as at Toledo and Kansas City, open these rooms only for special groups which are able to take complete charge of their own operations. On the other hand the Indiana State Museum will have both a lunchroom and a milk bar; several large museums, as at New York, Chicago, and Washington, have well patronized public restaurants or cafeterias; and one New York museum has a children's cafeteria as well.

The best place in the building for a public dining room is not a settled question. The restaurants of large museums have tended to be in the basement, for lobby control and supply and refuse disposal. But the basement may not be as open in buildings rightly designed for exhibition as it often was in the older type of high set museum, so that other positions are well worth considering.

The Museum of Modern Art gives a unique example in having its restaurant on the top floor, above exhibits and offices. This provides a pleasant setting, especially in the case of a museum in a congested neighborhood. Small museums with only a kitchenette for irregular use need to have this cubicle near a gallery or other space where people can gather, perhaps near an open court or patio in some climates. A way of accomplishing this without sacrifice of advantages gained through lobby control is by having the kitchenette give onto the lecture lobby (or the lecture hall itself if the floor of the hall is level and the chairs are removable). The less the kitchen's foodstuffs and waste go through the museum, the better. This might indicate a basement kitchen or kitchenette connected by a dumb-waiter with a room above, but there does not seem to be a museum with this arrangement. The Colorado Springs Fine Arts Center has a little ground-floor kitchen with one door leading to an entrance for supplies and another to a gallery for service at receptions. This is good in its own way, but it may be bad as a channel for thefts from the exhibits.

A staff lunchroom apart from the regular restaurant or the kitchenette is not usual, except that there is often a room near the lockers of the superintendent's force for eating lunches brought from home. Use of the kitchenette by the staff has been noted. Where there is a public restaurant, a staff table or section is the best thing; a separate staff room, as at Cleveland, is exceptional. The Rochester Museum has a third-floor kitchenette, in part for the staff, as well as a public dining room in the basement.

The kitchen or kitchenette should be properly constructed for fire protection, and must have forced ventilation.

CHAPTER X. ORIENTATION SPACE

Introducing the museum to visitors—especially to casual visitors who do not know what the exhibits have to offer—is a duty that museums have long performed haphazard in the lobby. The doorman and guards answer questions after a fashion. The employee at the lobby desk gives further, usually also fragmentary, information. But orientation, undertaken in earnest and promoted by special facilities, is something so new that planners have hardly begun to take account of it.

OPPORTUNITY to do something worth while in the way of orientation seems called for by familiar desires on the part of museum workers to give the public more help than they can under present conditions. Museum instructors, whose work with groups is rewarding, are understandably baffled by the lack of any chance to make parallel contributions toward the ordinary visits of the vast majority. Much of the brisk activity at the information desk is a kind of instruction and it deserves to be enlarged upon as the only personal contact the museum can have with the general run of its visitors. The arriving public's numerous serious questions call for more response than can be given to them in competition with perfunctory queries about rest rooms and when the museum closes.

Also, the somewhat aroused interest of people scattered through the museum is likely to make these visitors good prospects who should be grappled for. Museum librarians have often tried to fit reading matter, in addition to labels, into the normal course of a visit, and this has led here and there to reading corners and reading tables in exhibition rooms. The visitor is thus offered typed and printed messages, from collections of labels and simple gallery leaflets to comprehensive books. The Portland architect's memorandum recommended "some smaller rooms with library reference material and comfortable chairs." Swedish museums commonly have what are called "rest rooms," which are places with seats and reading matter but no exhibits. In several museums the library reading room has been placed near the lobby, with the idea of getting visitors to drop in; but this hope is not often fulfilled, doubtless because the library is thought to be reserved for its accustomed serious work.

Such efforts could receive telling practical support if advantage were taken of the fact that many a museum building now has space ideally placed for efforts at orientation—space which habitually waits to have something done with it. This is the entrance hall, or open place beyond the lobby. Such spaces, designed to afford architectural perspective and monumentality, have been used here and there for introductory and synoptic displays. But they have not been absorbed into true exhibition space because they have not been suited in their scale and character for installation of exhibits; and they have failed to be gathered into the lobby, perhaps because the strict functions of a lobby seem to end where the museum proper is entered. Whatever the reason, it is a fact that space just beyond the lobby has long been the one place in museums awaiting satisfactory use.

The obvious invitation extended by these circumstances is to create an orientation center with provisions for visitors to sit comfortably in pleasant surroundings and have a chance to do a little reading about the museum and its exhibits. This place should have the character of a public living room, with congenial furnishings including rugs. It presents to the designer varied and interesting opportunities in decoration, lighting, and furnishing. Here should be a space of refreshing atmosphere—the keynote area.

There have been several rooms of almost this kind. In the Berkshire Museum at Pittsfield, Massachusetts, the Crane Memorial Room was built in 1937 by remodeling a court into a chamber of partly domestic character. It has wall space for display, but primarily it is an orientation room with comfortable chairs and a table. Newark has long had a central gallery with rugs, not placed as exhibits but as rugs. The University Museum in Philadelphia had a pre-war plan to develop an orientation space of carefully studied character. And there have been other near hits of this kind, including many of the service-people's lounges set up during the early 'forties, as at Baltimore.

Orientation space should have a close relationship to exhibition space so that people going the rounds would be encouraged to come in often during the visit. It should be visible and easily reached from the lobby; but it should not be a thoroughfare, nor should it be barred by doors.

These requirements seem to suggest that in new buildings orientation space be planned in central position on the ground floor, perhaps with a surrounding corridor giving freely onto exhibits at the same level and, by convenient stairs, onto any exhibits above. A second floor of exhibits might be further related to the space below by having its corridor look down to the orientation room, as the arcaded corridor of the second floor looks into the empty court of many a museum.

In a large building with more than one exhibition block there could be more than one orientation space. Axial areas in museum wings have always been as short of function as the central entrance hall. Gilman pointed this out long ago, in relation to wings of basilica type. "The museum uses of the largest and most ambitiously designed spaces in the building remain to be determined," he said, suggesting that they might do for display of large objects or temporary exhibitions or for receptions and other gatherings—uses which have been tried with but little success. All too familiar are the sad halls of casts, tapestry courts, and makeshift places of audience in axial courts. Such persistently useless spaces in old buildings might be taken over for experiments in orientation.

Patterns of visitor behavior, as we shall see in the next chapter, make the central part of any exhibition area less successful than surrounding spaces. The central part, if developed as a haven for rest, contemplation, and reading, could receive the unhurried visitor entering at any side from a peripheral suite of display rooms. Precipitate visitors could then take the outside circuit, and be gone; or they could interrupt the outer circuit at will. This arrangement would tend to separate the interested or potentially interested visitor from the truly casual visitor—a separation which museums have long been seeking, largely in vain. Orientation might transform the museum from something hard to get the value out of into something very pleasant and fully satisfying.

CHAPTER XI. EXHIBITION SPACE

Exhibition is the characteristic and pivotal function of museums. The public judges the institution by the character of exhibits, and the building very largely by the character of exhibition space. Museums recognize the crucial role of their displays. It is not by accident that modern-looking exhibition rooms have been produced by remodeling within many an old structure that in other ways cannot live up to its new appearance.

ADAPTATION TO USES—by which is meant the shaping of space to the needs of temporary exhibition and two kinds of permanent exhibition—is a matter that deserves the planner's close attention.

Temporary shows, occurring mostly in art museums, are made up of pictures as a rule. The typical place of temporary display is therefore a suite of galleries for paintings; and the scale of these galleries is usually modest, since shows rarely include very large canvases whereas they are often of small prints. A museum likely to have shows of sculpture, or of other kinds of things with special demands, should try to anticipate these demands in arranging space.

Science and history museums do not get very far with temporary exhibition, although they advocate the idea and usually do what they can in ways that make no great calls for space. However, once in a while some science or history museum puts on a timely show that really overtaxes its facilities for the purpose. Such exceptional performances should have space captured from permanent display when it happens to be needed; and the space destined for such capture should be in a good position, not, as one sometimes notes, in some remote part of the building.

The right place for temporary exhibition space is on the main exhibition floor, at ground level and giving off the lobby. The rooms are best arranged for cutting off from the rest of the museum; but there should be no fixed barriers between this space and any other adjacent space, since give-and-take is very advantageous.

Permanent, or relatively fixed, exhibition should take some account of distinct needs for the general visiting public and for students. This difference, though not recognized by many museums even in exhibits, let alone in structural provisions for exhibits, is however beginning to appear rather commonly as a divergence of emphasis; and in a few museums it is strikingly reflected in the building plan. At Philadelphia, and less completely at Boston, great art museums have separate floors for the two kinds of display. In each case (unfortunately, as we now know) the public's exhibits have been placed upstairs and students' exhibits at ground level—this arrangement being a consequence either of the presence of skylights, which in the past have arbitrarily assigned importance to the upper level, or of architectural dispositions which have put open loft space above despite the museum's need for having it below. But, whatever has been done, the principle of separation in exhibits is entirely sound.

According to present thought, the main public displays should be brought into prominence by being relatively near the lobby—that is, on the ground floor if there is a choice between two floors, and forward, toward the lobby, on the exhibition floor at ground level. The earlier practice of farming out all available space to the different branches of a museum's subject matter, putting some important subjects in bad positions and others in good positions, or piling up subjects on successive floors, can no longer be defended. Rather, the best space should be divided between public exhibits of all the subjects represented, leaving second best space for study exhibits of the same subjects. A well organized museum will relate the public and study displays in each branch so that no confusion results.

There may be, in general, certain physical differences between the two categories of display space—differences that are predictable, not just to take care of particular possessions. Popular displays are likely to include large objects, period rooms, habitat groups, and working demonstrations; whereas study displays are typically made up of quantities of smaller objects compactly arranged. Therefore space for public exhibits, nearest to the lobby and nearest to the ground, tends to be planned on a larger scale as befits a scene of stimulated interest; and space for student exhibits, farther off or farther up in the building, tends to be of simpler character as becomes a place of detached and purposeful activity.

Some museums have set aside exhibition space for children, in a suite of rooms that may be called the "junior museum." Such space may be scaled down so that a low exhibition zone will not look out of place. But one should remember that children do not live in miniature houses. They are accustomed to rooms built for their elders.

DIVISION OF SPACE, carried out with attention to future as well as to present needs, should provide all possible capacity for change.

The most rudimentary kind of flexibility comes from construction permitting removal of any inner wall without disturbing the load-bearing walls and also without incurring excessive expense. Free-standing partitions meet this requirement, especially if they are not constructed on the scale of heavy masonry. Wood and lighter fabricated materials are used extensively for partitions, but the desire for flexible arrangements should not prompt the construction of dividing walls that do not reach the ceiling. Division of space by exhibition cases furred to the ceiling is increasingly common in science museums, as it could be in history museums and in some parts of art museums.

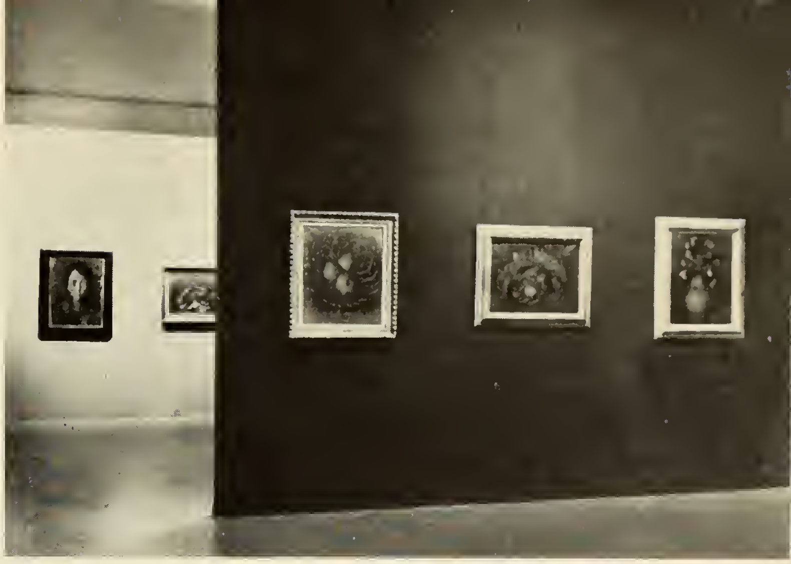
To assist in making changes, and for obvious other reasons, the building is customarily planned in uniform bays. Light-openings are placed with respect to these divisions. Lighting circuits, above hung ceilings and under flooring, are laid out on a corresponding module. Main air ducts are placed in shafts or between outer walls; and branch ducts, above hung ceilings, are arranged to reach any bay.

Another kind of flexibility, based on movable rather than replaceable partitions, has been noted at the Museum of Modern Art. Here each exhibition floor has open loft space interrupted only by supporting columns. Partitions, 7½ inches thick, of fabricated board on frames in standard units, are held at the bottom by friction and at the top with expansion screws against the ceiling. By shifting these floor-to-ceiling screens, spaces of various shapes and sizes are made at will.

Such division of space has important advantages in that it can take genuine account of the exhibit material shown. This has been encouraged by the rise of modern style, with its interest in rational planning; and, like modern style, it has been developing (though not in museums at first) since the 1920's. Lee Simonson, writing on the *Angles of an Exposition Plan* (*Journal of the American Institute of Architects*, July, 1927) gave an early statement that deserves to be noted again. "The problem of exhibiting . . . is a particularly modern problem," he said. "We relate our buildings carefully to our processes of living, to the mental and physical habits and routine of those who are to use them. But in planning our exhibitions we ignore the equally important psychology of attention and the very definite methods of presentation and architectural framing which will evoke or stimulate it. . . . To see a painting or any other object of art in the average gallery is about as satisfactory as going to visit a friend drawn up on parade with his regiment. . . . The major problem in planning any exhibition is not to let the eye see too much at once, to break up vistas, to isolate objects, to use every mechanical and constructional means to focus vision instead of dissipating it."

The mechanics of freely dividing space have not been worked out as yet with entire success. Flexibility of partition is comparatively simple; but, says Architect Goodwin of the Museum of Modern Art, "flexibility of light, and particularly of ventilation, is no joke." Movable light troughs that can be bolted to the ceiling at any point are now quite extensively used, and improved designs with baffles reduce their otherwise troublesome glare. Also the hung ceiling helps to solve problems, as we have noted. But much remains to be done through further experiment.

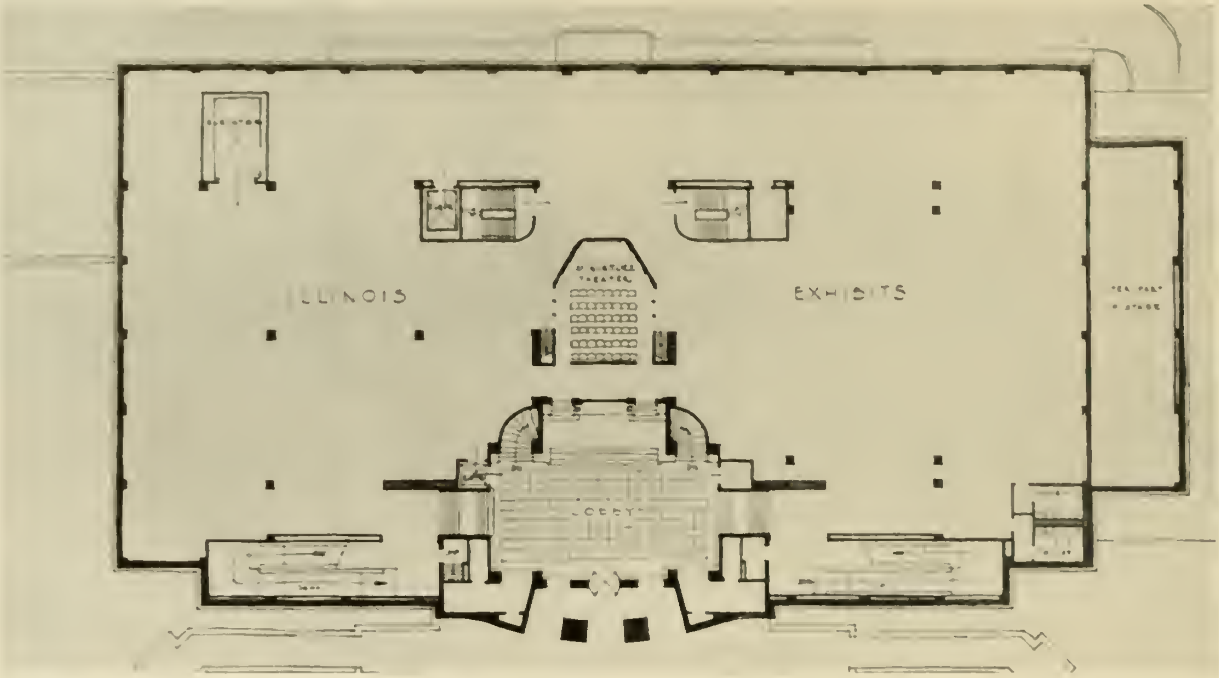
Some people do not accept the idea of adjustability in museums, holding either that it leads to change for the sake of change, or that it is at odds with the very spirit of a museum. The latter view has been well stated by the late Paul Phillipe Cret: "Assuming that the proposed screens and movable ceilings are practicable," he says, "what have we achieved by their use . . . ? Those works (of art) that have survived deserve a setting which has also conquered time and participates of this permanency. This can only be achieved through substantial construction. The recently completed rooms of the Sculpture Section of the Louvre afford an excellent illustration of this point. In design the utmost simplicity prevails. It is a simple background of walls, piers, and, in some cases, vaults without ornament or even mouldings; but these walls, these vaults, are the good, strong, thick masonry of the XVI Century gallery built for Catherine of Medici. The jointing and the stone texture are left apparent. Nothing is farther from the thin cardboard effect of movable partitions than this visible strength. As a result, the monumental sculpture there exhibited, be it Cinquecento or Egyptian, seems to have found its natural and final resting place. These rooms . . . are an excellent illustration of the value of permanency as opposed to the mobility which is desirable from another point of view. We are, then, confronted with a contradiction in the requirements of the museum: if the interiors are easy to transform, their appearance cheapens everything with which it comes in contact; if they are adequate to the works exhibited, they become costly to move or alter." (*The Museum News*, Dec. 1, 1934.)



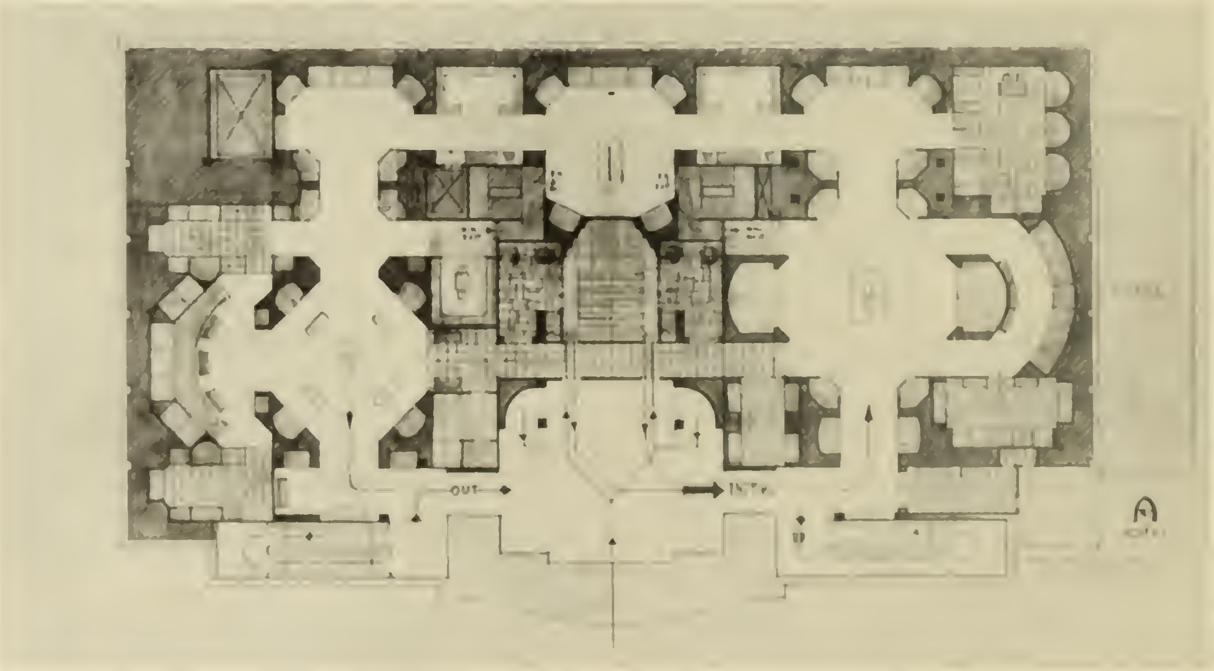
Courtesy Museum of Modern Art, New York

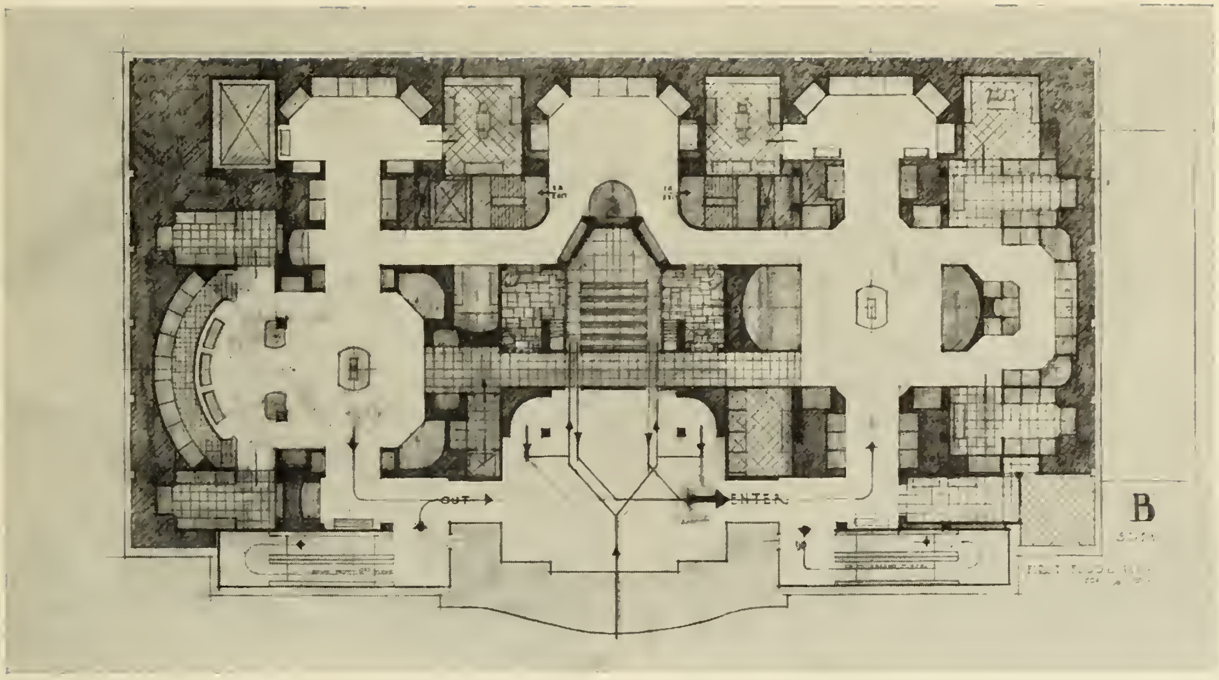
MOVABLE PARTITION (DARK) HELD AT TOP AND BOTTOM BY FRICTION, FORMS EXHIBITION LANE THAT CAN BE CHANGED

From these considerations, Cret concludes that "in museum planning, as in human in-

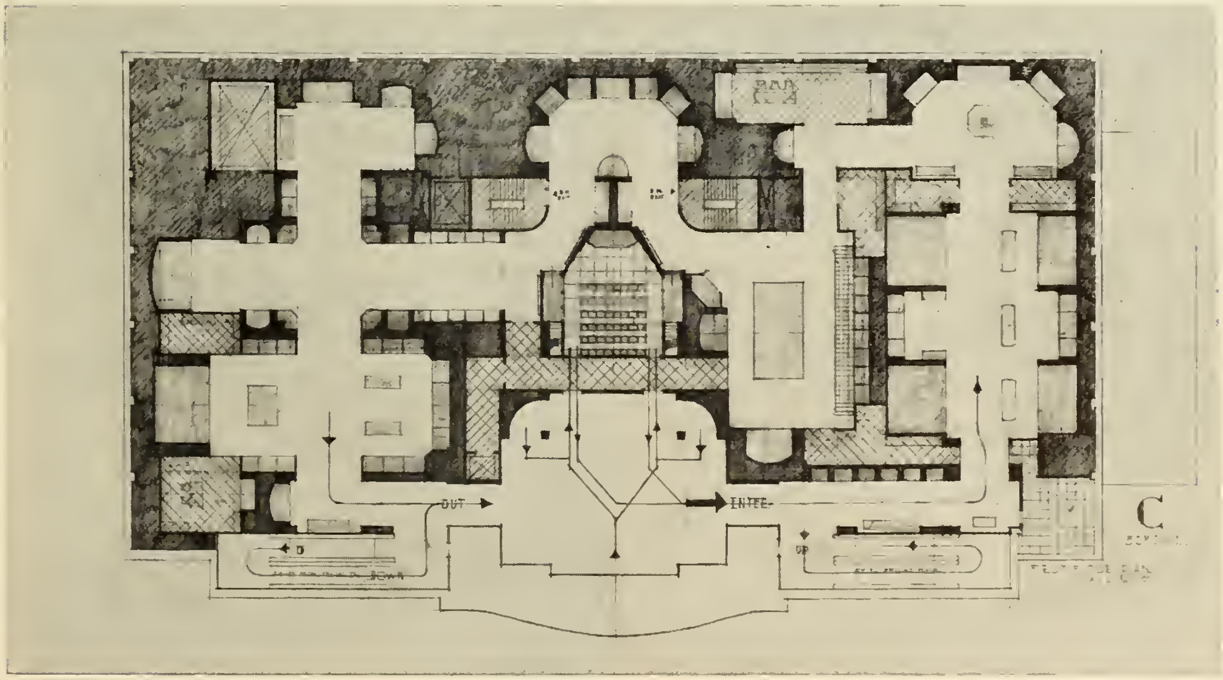


FIRST FLOOR PLAN OF PROJECTED ILLINOIS STATE MUSEUM SHOWING OPEN SPACE.
(BELOW) A SCHEME FOR EXHIBITS. C. HERRICK HAMMOND, SUPERVISING ARCHITECT





TWO OTHER SCHEMES FOR FIRST FLOOR EXHIBITS OF PROJECTED ILLINOIS STATE MUSEUM, SPRINGFIELD, SHOWING FREEDOM OF OPEN PLAN WITH FEW FIXED POINTS



stitutions, there is no perfect solution. . . . One age places greater emphasis on one item, while the next reverses the order." This seems to be the right verdict to which it must be added that the present puts emphasis on flexible construction in contrast to building fixed monuments of masonry.

It should not be inferred, from the growing interest in spaces of special shape, that rectangular rooms are in any way outmoded. Temporary construction may set partitions at angles and may employ curved furring or screens; but a fixed plan using such forms would be the kind of plan most likely to become nonfunctional.

A common device in sheathing the walls of picture galleries is to cut off the corners at 45 degrees by a wall face from 5 to 6 feet wide. This avoids a corner that may be poorly lighted, and it creates a useable surface for display, and sometimes a closet too. However, with improved technique of lighting, the square corner is no longer a serious problem; and, besides, some of the corner positions in any room are now likely to be used for doorways leaving central portions free for display.

Courtesy Palo Alto Junior Museum

FREE EXHIBIT PLANNING IN A SMALL INSTALLATION

Courtesy Museum of Science and Industry, Chicago

FREE EXHIBIT PLANNING IN A LARGE INSTALLATION

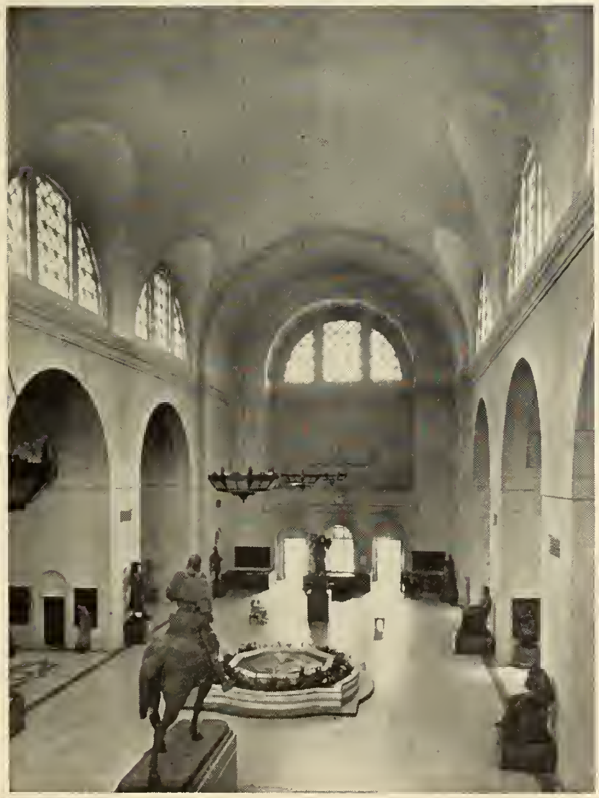
SCALE AND PROPORTIONS of exhibition rooms have undergone considerable change while the modern type of museum has been in the making. Spaces of intimate size are most familiar in recent buildings, whereas older buildings show many great halls.

Ceiling heights are much reduced on the whole. Gilman gave 34 feet as average in 19th century European museums, and something like this height may be seen in many of our own older buildings. But artificial lighting brought the ceiling sash of typical skylighted galleries to between 18 and 20 feet from the floor whether in the Toledo Museum of Art, as of 1912, or the National Gallery, as of 1941. For side lighted rooms, Boston early adopted a maximum height of 16 feet, which has since rarely been exceeded. Further changes in artificial lighting have called for still lower ceilings in both top lighted and side lighted rooms, so that in many recent buildings rooms of varied use have heights between 12 and 14 feet. For small rooms and partitionable spaces, 10 feet is about the minimum. There are, to be sure, some ceilings at 9 feet, but most observers find them excessively low. Typical of recent rooms with mixed lighting are those of the Cranbrook Academy of Art, with main-floor ceiling heights variously of $17\frac{1}{2}$, 16, $14\frac{1}{2}$, and 13 feet, and of the Rochester Museum with heights of $16\frac{1}{2}$, 14, and 11 feet. Even the central space of the main floor at Rochester is only $16\frac{1}{2}$ feet high. Large high spaces continue to appear as required, but such spaces are no longer taken for granted.

Suspended ceilings, or hung ceilings, which are of light construction and are separate from structural ceilings, are now the usual thing (page 137). The most obvious advantage of hung ceilings is the improvement they make in appearance by concealing overhead beams; but there are other important practical reasons for this construction. Space above a hung ceiling is useful for air ducts and lighting circuits, and for recessing of flush lighting fixtures; in fact, the last of these uses is now so far developed that assemblies of acoustical ceiling material and inset lighting troffers (page 104) are employed in flexible arrangements designed for specific—often temporary—room requirements below. But considerably more space than could be needed for any such purpose is provided in some museums for possible adjustment of ceiling height through simple remodeling. Generous overhead space also allows for putting in period rooms with extra height requirements, and for installing habitat groups needing clearance to take in the curve of the artificial sky and the top lighting box. Hung ceilings at heights of from 12 to 16 feet, under reinforced concrete ceilings that give clearance of from 17 to 20 feet, provide all the leeway likely to be required. Clearance of 20 feet under beams is enough for all but the very largest period rooms and habitat groups, although there may be requirements up to, say, 25 feet.

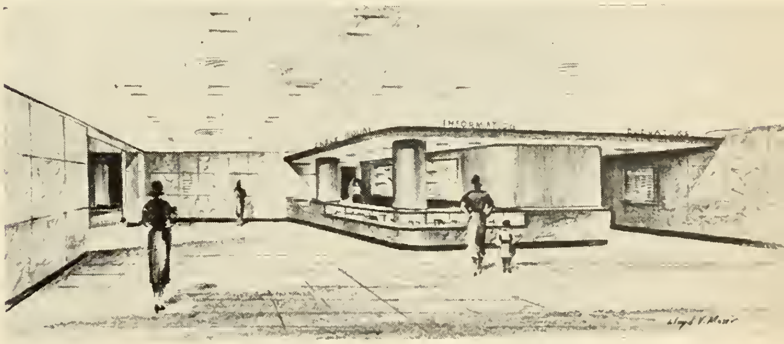
GRAND SCALE AS SEEN IN MAIN ENTRANCE HALL OF AN EARLY NEO-CLASSICAL MUSEUM BUILDING

Courtesy City Art Museum, St. Louis



MODERN INTIMATE SCALE SEEN IN PROJECTED ENTRANCE HALL. WALTER SCHOLER AND BEINE, HALL AND CURRAN, ARCHITECTS

Courtesy Indiana State Museum, Indianapolis



Room size, in plan, is difficult to generalize about, except by noting the tendency to reduce. This may be seen even in large recent buildings, witness the National Gallery in which typical rooms are of the order of 20 by 35 feet and 25 by 40 feet. Widths of 20 feet more or less, with lengths of at least $1\frac{1}{2}$ times the width, are now usual. The great hall of exhibits can hardly be pronounced a thing of the past, especially at a time when there are huge industrial and aeronautical museums in prospect; but scale for the sake of monumentality has certainly been rejected.

TYPES OF EXHIBITION ROOMS are associated more or less closely with different kinds of buildings, and with methods of lighting. It must be noted that modern ways of dividing space are to some extent at odds with the conception of a room as such. However, space divisions made by any means reflect much the same needs that have produced the older room-types, so that a review of familiar types seems in order.

The simple chamber of moderate size with an ordinary, not to say domestic, arrangement of openings is the commonest kind of room. This type appears in buildings of many kinds, and is the usual vehicle of exhibits for the small museums occupying residence-like structures. Such a room may be satisfactory if exhibits are self-lighted artificially. The general lighting from windows may be inadequate by day, and must of course be replaced artificially at night. If windows are at one side only, control of glare is not difficult; but the best results may come from having windows at one end of the room. Some very congenial small galleries are in slightly remodeled residences, with token light from end windows and added artificial room and object lighting. The Phillips Gallery in Washington shows examples, and several history museums have good rooms of a similar kind.

What we have called elsewhere the corner lighted room (page 89) is a specialized form of the simple side lighted chamber. It has only one light opening, near an end of one of its longer walls.

Another specialized kind of side lighted room, with windows placed high in one wall, perhaps as a continuous strip, appears in many museums. The type is good in principle, since light from a high level should not reflect from cases and also since high windows leave the wall below them free for use. However, because of tall exhibition cases and absence of proper object lighting, this kind of room is not always workable.

Differing principally in scale from the ordinary side lighted room, is the large side lighted exhibition hall. This type is seen in the older science museums, in which it commonly occupies an entire floor of a wing. The windows, spaced regularly between piers and extending from low sills to a high ceiling, have been so often blocked off partly or wholly in remodeling that halls so lighted are clearly not satisfactory. Nevertheless, for display of large objects, as most commonly in museums of industry, rooms of this kind may be required.

The hall with a balcony is a familiar room form, and also one of the oldest. Sometimes it has tall windows below and above the balcony on one or both sides, and sometimes it has no windows at all. Rooms of this type appeared first in early science museums built on the box plan, and were a borrowing from still earlier library buildings. The room began by having several balconies; but with one balcony it became an established type, appearing in many museums including some of the latest. There are examples in large buildings, as at the American Museum with its hall of ocean life; and there are others that form the major parts of small buildings, as at the Kingman Memorial in Battle Creek. Old examples look antiquated; but after remodeling in newer fashion they look very modern indeed, as can be seen in Chicago's Museum of Science and Industry and again in the recently remodeled geology hall of the Academy of Natural Sciences of Philadelphia.

The balconied room should not be confused with the balconied court—the latter being usually skylighted, in buildings more or less like the Fogg Museum at Cambridge. The court is a central space encircled on each floor by an open corridor giving onto outside rooms. The court in this arrangement, though sometimes impressed into use for exhibits, is really an architectural feature associated with a certain grouping of rooms.

The clerestory hall (sometimes called a court) is a great hall with windows far up on two sides. It may be flat topped as in the Buffalo Museum of Science, or vaulted and with piercing dormers as in the Detroit Institute of Arts. This sort of space is not very well adapted to use for exhibition.

The skylighted picture gallery is the commonest type of room in art museums. To the visitor such rooms seem to be of the simplest character, like big boxes. But to the museum planner they are the most cumbersome contraptions in the whole planning repertory—blocks of two stories, with the upper compartments for costly and troublesome lighting installations, able collectively so to dominate the building of which they form necessarily the major part that the architect has no chance to consider space organization in a fully rational way. "Skylighted rooms are devils," said one architect, voicing the feelings of all who have had to struggle with them. However, as observed in our discussion of lighting, skylights are no longer the only means of lighting picture galleries well. They are available for adoption in any part of a building where conditions they impose are acceptable, but they can no longer dictate the planning of art museums.

Another type of room, the skylighted great hall, which sometimes takes the place of the clerestory hall, is in effect a court and is commonly treated as an outdoor space in spite of its double-glazed covering. The indoor garden court, with gravel beds and plantings and perhaps a fountain pool, is familiar in art museums and deserves a place in museums of other kinds. Its best use, aside from being a focal point of some interest in itself and a refresher for visitors, is for music—of which there is more said in Chapter XIII. The garden court (and, in fact, the skylighted court with no garden) is sometimes used to show sculpture, although its lighting is not favorable for this. In some buildings, as noted above, there is a skylighted central space embraced at each floor level within a corridor; and such a space may have garden features and the same uses as any other enclosed court. But the court, whether covered with glass or open to the sky, is not an exhibition place except perhaps by chance or necessity.

The exhibition corridor is another type of space—used like a room, although it is not a room. Corridors are by nature only passageways; but space is at a premium in museums, and corridors are so regularly pressed into use for display that without exhibits they may even seem to be empty. In view of this, corridors should not be too narrow. What *too* narrow is, specifically, depends on the size of the building and on whether the corridors will have to be used in moving large exhibits. Also, passageways should not run far in a straight line. They are best lighted artificially. Flush overhead fixtures with controlling lenses can give a satisfactory result. Usually enough natural light spills into a corridor from adjacent spaces to meet the psychological requirement. A window looking down a corridor from the end is disturbing, even though there is little glare; and a window facing a door into a room may be disturbing. Skylights in corridors seem very much out of place, to say nothing of practical disadvantages.

The type of room that is in effect an allotment of space, free to be divided when exhibits are installed, is the final type. As a rule it is windowless; but it may have openings for natural light—either separate windows or, more likely in the future, a ribbon of glass that can be screened by a diaphragm with openings placed as desired for particular purposes. This brings us again to the fact that in modern design the room as such gives place to the parcel of space defined in not too permanent a way.

Three familiar kinds of rooms not given in this review are cabinets, period rooms, and places designed for habitat groups. These are, in truth, not types of rooms but special uses of space.

Cabinets are like alcoves formed by partitions. Traditionally, since their adoption in early museum buildings of Munich and Dresden, cabinets have been planned in file along one side of a long space with windows opposite. The passage from cabinet to cabinet is along the wall by the windows, and it may be defined by a series of doorways or left open as an unpartitioned alley. Stein has discussed such cubicles (*Making Museums Function*, *Architectural Forum*, June, 1932) in relation to their use for isolating art objects, noting different ways of splaying the sides to facilitate lighting. There are files of cabinets at the Metropolitan Museum and a few other places, but the form has been used with restraint.

Period rooms, in art and history museums, may seem from the visitor's standpoint to be small exhibition rooms, but to the architect they are exhibits requiring space for their installation. In many museums, to the embarrassment of the management, period rooms when acquired have had to be fitted into rooms that were either too small or wastefully large or wrong in shape, or that offered some very awkward arrangement of light openings. The best provision for period rooms is undivided space, at best with ribbon windows that can light through antique windows set up near them. Vertical clearance of 20 feet is ordinarily sufficient for period rooms. Undivided space of this height can receive installations of antique paneling and the like, in almost any size and shape.

Habitat groups in science museums may occupy rooms designed to receive them, but ordinarily they are installed in space that could have other uses. For the largest of groups (a giraffe group probably excepted) vertical clearance of 20 feet is enough, and 14 to 16 feet is usually ample.

It may be noted that a new sort of room may be evolving to take care of combined display and curatorial work such as goes on in some departments of a few museums (Chapter XV). A room of this kind might have display space below, and perhaps a partial mezzanine for curatorial work and study. It is too early to say what spacial forms will result from this union of functions.

GROUPINGS OF ROOMS in exhibition areas have to do with the general organization of space in the building; but within this framework there are some familiar patterns that relate to different methods of lighting and different routings of visitors. Lighting used to be the determining factor in most cases; but, with the variety of lighting means now at the planner's disposal, circulation has a larger part in deciding what will be done.

Although rooms as such are under question within the modern program, it is convenient to speak of space divisions as rooms and to remember that they may not be rooms in the older sense, and may not be fixed.

The room-to-room arrangement, with space laid off in a continuous suite of chambers, appears at its simplest in small buildings of one story with exhibition rooms on either side of the lobby or entrance hall. This plan is developed by adding rooms in single, double, or triple file. Thus extended, the building may take on L, U, H, T, or E shape or some irregular ground plan. By joining wings around courts, hollow rectangles and lozenges, entire or bisected, are produced.

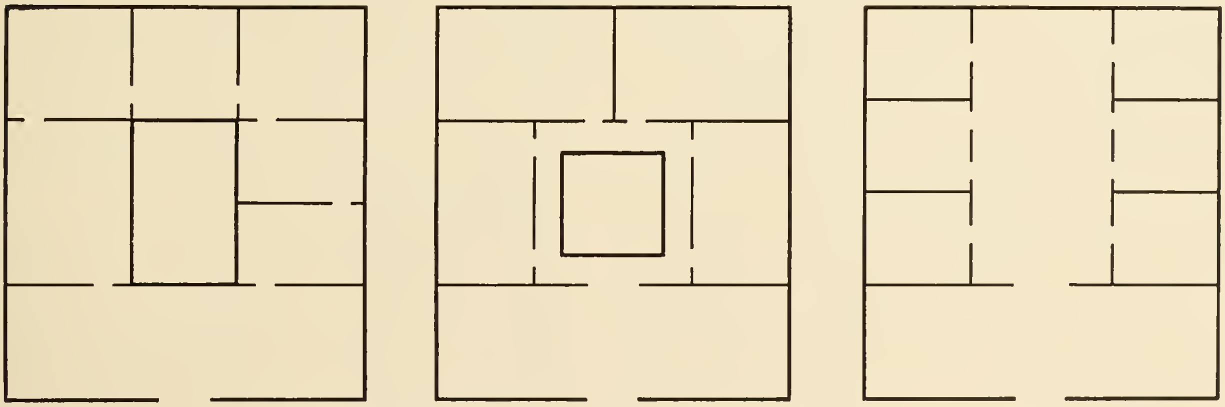
The advantages of this common grouping are its possible simplicity and its economy of space. The principal disadvantage is that when a room is closed the circulation of visitors is seriously disturbed if not blocked altogether. In very small buildings the continuous scheme is satisfactory; but in larger buildings it may give trouble unless the building is large enough to have multiple files of rooms. This arrangement often shows also a partial adoption of some other plan, as where rooms are in triple file with the central file treated as a permanent corridor. At the Philadelphia Museum of Art, for example, the middle file is emphasized architecturally by greater size of rooms and larger doorways in order to give a main avenue of travel.

There is a modification of the usual continuous arrangement in the Allerton Wing of Chicago's Art Institute deserving of remark. This is the adding of a service passage between galleries in double file. The passage takes care of pipes, ducts, wiring, circuit-boxes and the like, and is also for the purpose of getting at space above the hung ceilings of rooms on either side.

Room-to-room plans are sometimes laid out around spaces to which they bear little or no relationship. Thus a suite may encircle a court which can be seen but not entered, as at Chicago's Oriental Institute, or a court which can be entered for the sake of diversion apart from any route, as at Kansas City's Nelson Gallery. But where the connected central space serves as a thoroughfare—whether indoors, like the central gallery at Providence, or outdoors, like arcaded patios at Santa Fe and Honolulu—the plan is partly of another species.

The corridor-to-rooms arrangement (often called the room-and-corridor arrangement), in which each room is accessible from a passageway, has been used in museums for more than a century, since its first adoption for the Old Pinacothek at Munich which had a lateral

FAMILIAR GROUPINGS OF ROOMS: ROOM-TO-ROOM ARRANGEMENT (LEFT), CORRIDOR-TO-ROOMS ARRANGEMENT (MIDDLE) AND NAVE-TO-ROOMS ARRANGEMENT (RIGHT) ALL USED FREELY IN MODERN BUILDINGS AS WELL AS ASSOCIATED WITH HISTORICAL STYLES



corridor giving access to its main file of rooms. There was a straight connecting corridor in part of Philadelphia's Memorial Hall (1876), but our own first full use of the scheme was in Chicago's Art Institute (1893) which had a corridor around the then open court of each wing communicating with a single file of outside rooms. Boston's building of 1909 has a corridor around a central gallery in each wing, and arms of the passages reaching to corner pavilions.

In museums of the last two decades, including museums of science and history as well as of art, the corridor-to-rooms plan has been employed in old and new arrangements. The corridor hugs a central open court at Houston, and it takes in also a room beside the court at Washington's Freer Gallery and the Columbus Gallery. The corridor becomes an outdoor ambulatory around a patio in the Santa Barbara Museum of Natural History and the Norton Gallery, West Palm Beach. At New York, where weather is more severe, the ambulatories of The Cloisters are enclosed with plate glass during winter months and can be used throughout the year as corridors. In winter these corridors are kept five degrees cooler than the adjoining rooms, partly to save fuel and partly to help the visitor think he is stepping into the open. In some other buildings the corridor is associated with a central covered court, having the form of an ambulatory around space on the main floor and of balconies on each of the floors above. The Fogg Museum at Cambridge and the Worcester Museum are typical in this respect of a dozen buildings, most of them belonging to art museums. The Springfield Museum of Fine Arts has the central court at a higher level than the main floor corridor, and the Avery Memorial at Hartford has the upstairs balconies cantilevered over the margins of the central court. The main floor corridor lies between an outer and an inner series of rooms at Kansas City's Nelson Gallery, and also at the New York Historical Society as recently remodeled, and the Nebraska State Museum (where, however, the outer rooms are not for exhibition). In some buildings, the corridor follows not a circuit but a long axis, as at the Museum of the City of New York; and corridors follow two long parallels at Omaha's Joslyn Memorial.

The principal advantages of the corridor-to-rooms arrangement are that any room can be reached directly, and therefore can be closed without affecting other rooms, and that the scheme of circulation is clearly indicated to the visitor. To be sure, the corridor takes space; but the loss is often recovered in part by using corridor walls for exhibits.

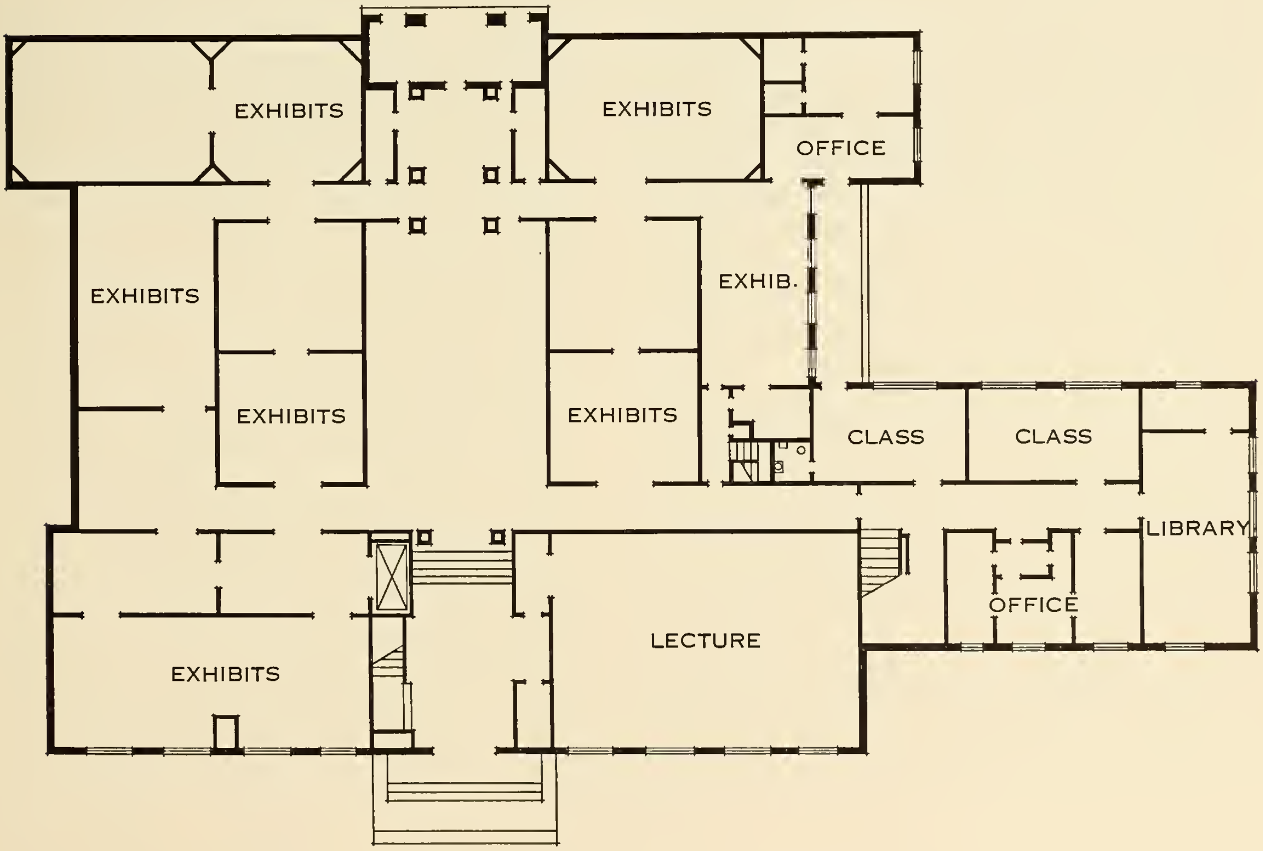
Although most often in the past this scheme has been employed in buildings with space, open or closed, around which the corridor could form a rectangle, it now tends to be used more freely in response to freer building plans. In the Dallas Museum of Fine Arts, for example, the course of the corridor passes alternately between double files of rooms and through spaces which themselves might be construed as wide portions of corridor. Other plans worth studying are those of the Colorado Springs Fine Arts Center, the Portland Museum of Art, and the Fine Arts Building of the University of Iowa. There are hints also in some of the older buildings, among them the Yale University Art Gallery, the Corcoran Gallery's Clark Wing and several small buildings of early American style, as for instance the Mystic Art Gallery, Connecticut; but the best examples of free planning with corridors leading to rooms are in buildings of modern spirit.

The nave-to-rooms arrangement is centered on a large chamber with doorways along the sides giving onto smaller rooms arranged in single or double file and variously connected among themselves. The large chamber typically has a clerestory, and the scheme then shows something like the interior of a basilica with aisles divided into rooms.

The arrangement has been familiar in American museums since an early adoption in 1855 for the west range of the Smithsonian building at Washington. There have been elaborations of the scheme which have left it hardly recognizable, as for instance in the City Art Museum, St. Louis, 1904, where the aisles are extended as wide flanking suites of intercommunicating rooms, and at the Chicago Natural History Museum, 1921, where the aisles are multiplied and the outermost aisle on each side is extended as a series of parallel wings joined at their extremities by still another aisle. However, simpler examples are also common, as may be seen in art museums at Rochester and Hagerstown and science museums at Buffalo and Grand Rapids. Treated plastically in the recent general museum at Rochester, the form is that of a windowless axial space of moderate scale, flanked by lower windowless spaces divided freely into alcoves and small rooms. Although the arrangement is most flexible with respect to the treatment of its aisles, it may be wholly flexible if the nave, or axial court, is not treated monumentally. The scheme lends itself to exhibits showing a survey of a subject in room after room, with general exhibits in the larger space.

These three patterns, though they are associated historically with certain architectural styles, are really functional shapes that can appear in any setting.

MAIN FLOOR PLAN OF DALLAS MUSEUM OF FINE ARTS, TEXAS, WITH ROOM GROUPINGS IN TRANSITIONAL TREATMENT. ROSCOE DE WITT AND ASSOCIATES, ARCHITECTS



SUPERVISION of exhibition space is an important maintenance problem which projects itself back into planning. Rooms should be laid out to provide for their being watched effectively by the smallest possible number of people.

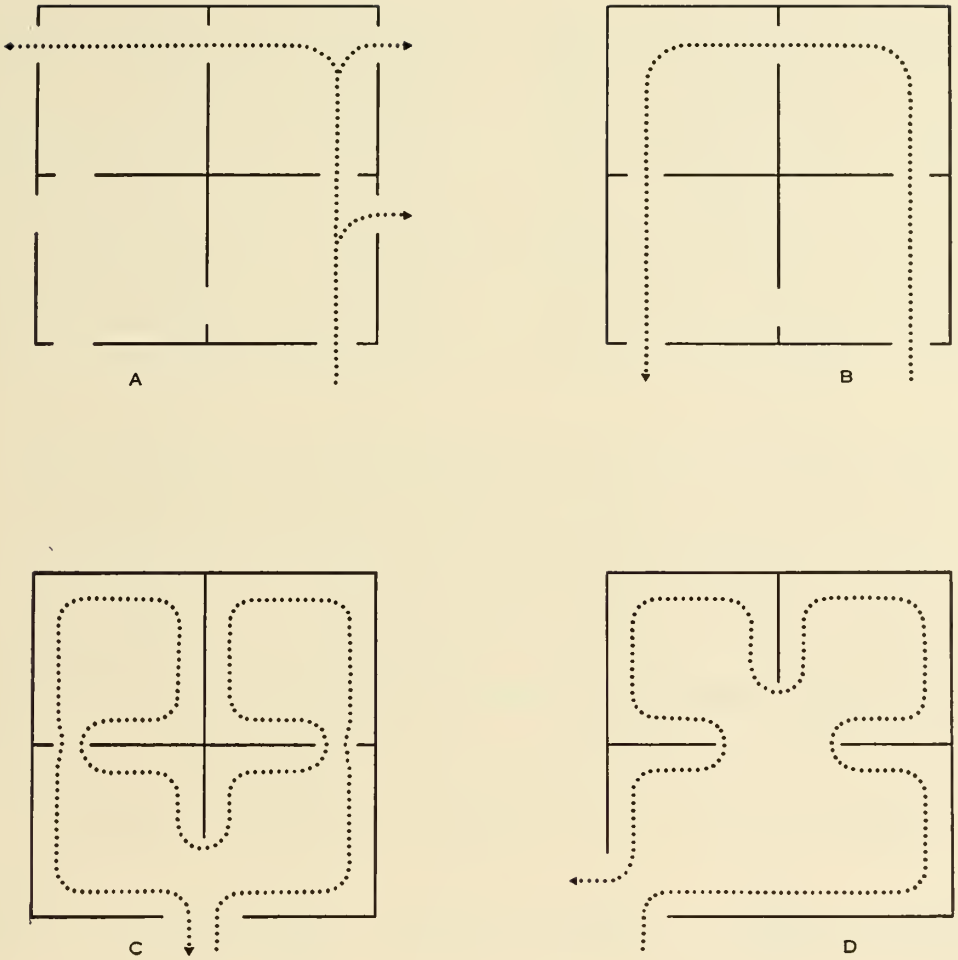
A very small museum may have to be laid out in such a way that the lone person in charge can supervise from his regular place of work. Completely open space gives one solution of this problem. Sometimes the office is at a point of vantage on a balcony, or on a partial, open mezzanine above other work rooms. A glass partition between the office and the exhibits may give the director's desk a full view of public rooms. Schemes using mirrors to command critical angles of sight are never successful.

Larger museums, especially those in communities large enough to sustain troublesome dishonesty and vandalism, have a watch problem that calls for special guards—usually uniformed men, though sometimes women switched back and forth between office work and duty in the exhibits. The number of guards could be reduced in most buildings if the architect had anticipated the positioning of watchers and had avoided arrangements making it hard to keep an eye on things. However, long vistas through doorways do not necessarily help the watcher since danger points are not on lines of passage from room to room, but off these lines where visitors are closest to exhibits.

The use of office workers for guarding and the circumstance that a small museum's office may also be a watch point are, both of them, suggestive of a scheme for large museums noted elsewhere in another connection (Chapter XV). This is the proposal that curatorial space in some if not all departments be placed on mezzanines above their own exhibits.

CIRCULATION, or the movement of visitors in exhibition space, takes its pattern from the layout of the building; but how the visitor responds to the space arrangement may be affected by the exhibits and is ever influenced by a complex of human habits called visitor behavior. Routing, or precontrol of circulation, seeks to take account of these factors in getting one or another desired result. It should be noted at once that a building may have excellent circulation without having good routing. Good routing promotes full and orderly coverage of exhibits by the visitor who yields himself to the arrangements made for his guidance; but under no circumstances should the routing interfere with free circulation of visitors who desire to move at will. Forced passage through a few rooms at a time is not objectionable, but a single unalterable route through many rooms (as through all the exhibits of certain large European museums, notably the Bavarian National Museum at Munich) is often exasperating.

The principal difficulty with any routing scheme is that it has to make a compromise between arranging for a majority of casual sightseers and for a minority of interested people. With the main crowd the objective is to promote exposure to the principal exhibits in order, with the least possible difficulty and confusion; but with the smaller number the objective is to assist selection and concentration. Division of exhibits into public displays and (less public) study displays is one response to the double objective. A still further response in planning might be along the line, already suggested, of having even the main public exhibits arranged for different rates of progression by providing an outer circuit of rooms for everyone and an inner area for those who care to prolong the visit—the latter area including orientation space, for reading



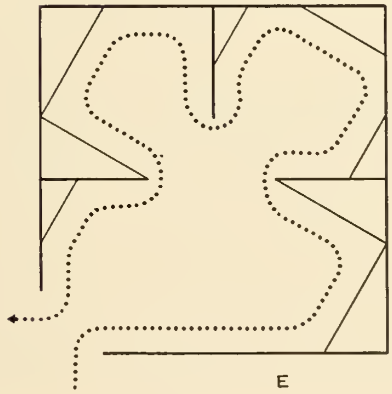
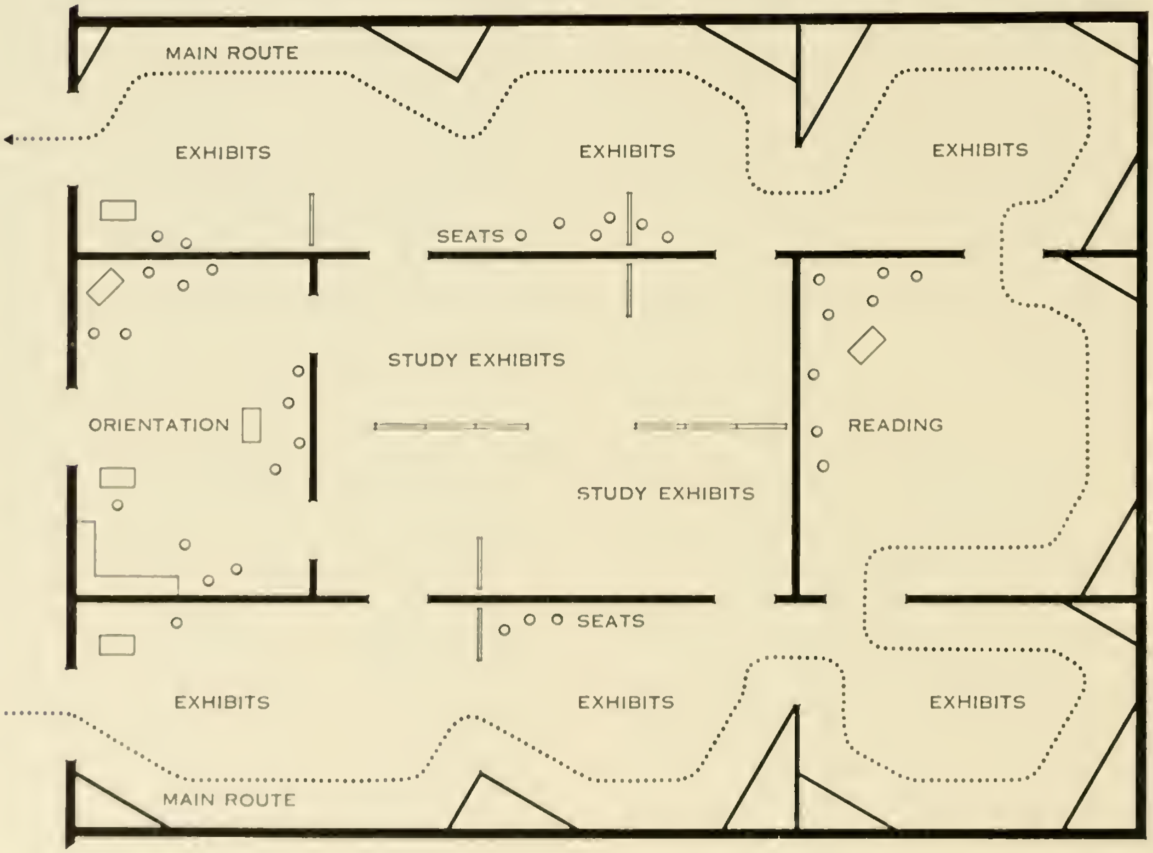


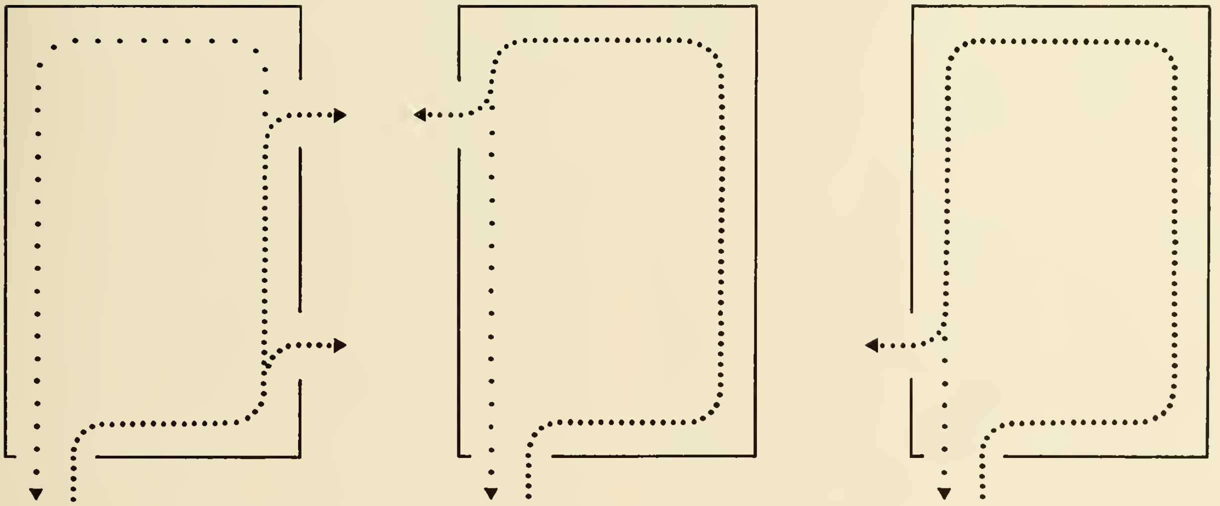
Diagram of arrangements that give: (A and B) free circulation but probably poor coverage, (C) coverage at the expense of movement, (D) a compromise for circulation, coverage, and possibility of seeing exhibits in logical order. Last arrangement (E) is a development of scheme D for exhibition and contemplation, and perhaps communicating with study rooms in curatorial quarters. The casual visitor's rate of passage could then be as swift as his walking, and the more interested visitor's pauses could be varyingly frequent and sustained. If a suite of exhibition rooms left no space for a separate orientation room, part of the function of such a room could be allocated to the left side of each exhibition room. Right walls could then be for principal exhibits and the hastening throng could pass them as quickly as might be desired. Such a scheme would meet the visitor's habits of action.

Visitor behavior is best examined in terms of what a person will do in a single room—that is, where he will go in the room and what he will look at. Methodical studies of visitor behavior by Robinson, Melton, and others (reported by Arthur W. Melton in *Problems of Installation in Museums of Art*. American Association of Museums, 1935) have shown

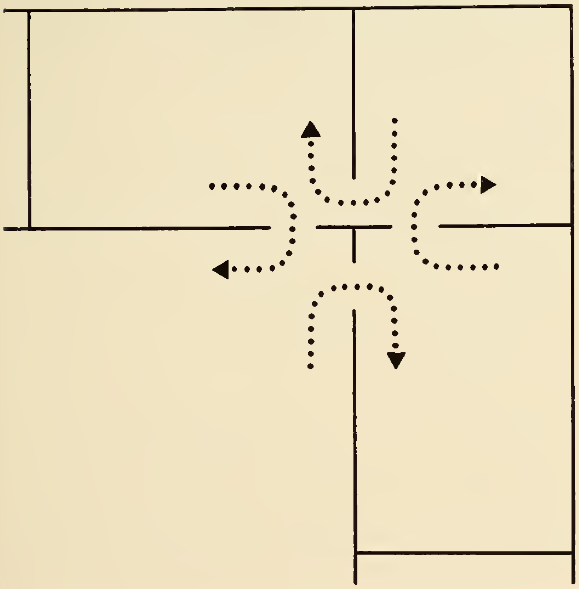
DIAGRAMMATIC GROUND FLOOR PLAN OF UNIT WITH OUTER CIRCUIT FOR CASUAL VISITORS AND CENTRAL SPACES FOR MORE SERIOUS VISITORS. ON THE OUTER CIRCUIT, WALLS AT THE RIGHT ALL THE WAY AROUND ARE FOR THE PRINCIPAL DISPLAYS AND WALLS AT THE LEFT BOUND NOOKS FOR SITTING AND READING. THE CENTRAL SPACE WITH ITS CHANGING STUDY DISPLAYS MAY BE REACHED BY WAY OF AN ORIENTATION ROOM OR FROM MAIN EXHIBITS. SUCH AN ARRANGEMENT WOULD TAKE ACCOUNT OF FACTORS TENDING TO STULTIFY USUAL SCHEMES ROUTING ALL VISITORS ALIKE



that wall and floor space *at the left* as one enters a room is of relatively small display value, and that "exit attraction" is one of the powerful pulls in museums. Yet in the face of these facts, museums nearly always install exhibits to be seen from left to right as one would look at things posted on a bulletin board; and architects place doorways where they can draw off visitors without regard to what the visitor is supposed to see. The result, where exhibits have the usual clockwise sequence around a room, is that the visitor starts with the end of the series, and if he encounters a doorway before completing his tour of the room he stops perhaps in the middle of the subject presented. This is less of a difficulty for aesthetic than for didactic displays, and therefore is least troublesome to art museums; but the problem is real in a museum of any kind.



DOORWAY PLACEMENT AND EFFECTS ON ROUTING: EXIT ATTRACTION IGNORED (LEFT) EXIT ATTRACTION ASSISTS COVERAGE (MIDDLE), PROMOTES COVERAGE (RIGHT). THREE ROOMS, ALL OF LAST TYPE, ARE SHOWN BELOW IN A FAMILIAR GROUPING



The obvious solution is to give the visitor exhibits mainly at his right to look at, and to install the exhibits for inspection from right to left, counter-clockwise, in a room. The common device of trying to force left turns at doorways and clockwise circuits of rooms is not effective, except perhaps on British soil where the habit of turning toward the left is indigenous.

Types of circulation, corresponding to different space arrangements, have their roots as a rule in the lobby. In most museums the lobby gives a view of the general layout, offering a natural circuit or an obvious choice between several parts of the plan. Here, especially, the right turn might as well be accepted, since a start at the left is confusing and hard to enforce. Crossing traffic lanes should be avoided; the lane to the lecture hall, for example, should not cut the flow of visitors from one area of exhibits to another.

An open central space beyond the lobby (dismissing orientation possibilities for the present) often serves as an aid in keeping one's bearings. Some buildings have two or more of such hubs. The Detroit Institute of Arts has three, each of different character: a courtyard seen through windows, an enclosed garden court, and a block of temporary exhibition galleries. A corridor around such a hub may further simplify routing.

The natural right turn, at any point of choice between directions, may well be indicated also by suggestion or instruction. Where a left turn has to be made, some such aid is necessary. Architectural devices including large doorways and vistas are partly effective; and baffle partitions are sometimes employed as well. Direction markers may be used, and if they take the form of master labels they are doubly helpful. A few museums have tried lines in flooring and arrows or shoetracks painted or otherwise marked on the floor, but these means are often rather discordant. Framed floor plans with marks to show whereabouts and directions are understandable to some people, though just too much for others.

Routing within one room is ordinarily planned as a loop or a looping meander, but all too often carried out by the public as a direct transit. A room with one opening for both entrance and exit imposes a circuit — which, alas, the visitor sometimes performs only mentally while standing at the doorway. A room with two doorways has exit attraction to pull the visitor in, but the benefit it gets from this depends upon where the exit is placed in relation to the entrance. An exit at the far end of the room gives the wall at the right a good chance of having attention. An exit near at hand in the right wall may make the room almost ineffective. But an exit in the left wall, granted attractive exhibits, gives the room a fair chance of being ordinarily three-quarters observed. In order to save the middle part of each wall for display, the doorways are best placed well off center if not near a corner. In general one can say, first, that at best a room has two openings (sometimes required by local fire laws if the room is of more than designated size or capacity); second, that openings should ordinarily not be on axes; and third, that the exit should not be where it can siphon off the stream of visitors before the stream has passed naturally around as much of the perimeter of the room as the planner hopes to have the general public traverse. Use of the neglected quadrant for orientation, in the spirit of the reading corner, has been suggested.

If the room is a very large hall or an open space, there may be routing by baffles and screens, or there may be an alcove plan. Where exhibits need to be approached in sequence, they should start at the right as one enters and follow a counter-clockwise course. However, the contents of an individual exhibition case, or of a single panel, may of course be installed to be looked at in the reading order of left to right.

Routing in a suite of rooms is difficult — may in fact be impossible — to perfect because a connecting doorway is often subject to conflicting demands of two rooms. However, the planner should consider every group of rooms in the light of the separate requirements of each room in turn. The usual, but not very studious, compromise in room-to-room arrangement is one of doorways balanced to right and left of center, with only occasional axial openings. Too many doorways in line give a vista that pulls the visitor along as though in a current. Short diagonal vistas through two doorways, are sometimes relieving to the eye; but in general what one sees through a doorway should be an exhibit, not another doorway. A self-contained suite with a studied arrangement of doorways can give maximum coverage of walls if the visitor merely keeps to his right, but this route is disappointing if the rooms are installed as units and then seen partly on the way in and partly on the way out. This plan, too, has the effect of a dead end unless doorways are wide or the line of passage is divided into two lanes. A file of rooms through which the visitor goes in one direction only has the advantage of correct sequence, but with poor coverage in any room unless the visitor makes a business of looping in his path. In a double or triple file of rooms with interconnecting doorways, the best that can be hoped for is intelligent browsing—which is really too much to ask of the general public. However, a triple file can be made into what comes close to a corridor-to-rooms arrangement by emphasizing the center file as a passage.

Routing in corridor-to-rooms and nave-to-rooms groupings can be under much better control than in room-to-room arrangement. In either of these schemes, if strictly held to, there is a branching route; and therefore rooms can be dealt with individually. But where interconnecting rooms or self-contained suites are entered from a corridor or nave, the circulation problem is again complicated by the difficulties that go with room-to-room arrangement.

A new scheme, seemingly as limited as it is ingenious, has been offered in Wright's plans for the Guggenheim Museum in New York. Here the exhibition space is in one narrow gallery, three-quarters of a mile long, coiled into a spiral ramp ascending through nine turns. This runway is reached at each turn by elevators with their shafts encircled by a tight spiral of "fast" ramp. The visitor can thus begin at any level and go as far as he wants to in either direction. This kind of routing could be approximated in a stack of circular routes on successive floors of a tower. Something like this is seen in the project for the Indiana State Museum with ramps between exhibition floors.

INTERIORS of exhibition rooms should meet the needs of exhibition. They should not compete with exhibits. Columns, pedimented doorways, heavy cornices and elaborate moldings, patterned floors, obtrusive details, and ornamental fixtures of all kinds are out of place here, no matter what the style of the building. However, it must be added that buildings in modern style do not give occasion for decorative trappings but require instead just simple interiors such as best serve the purposes of exhibition. This fact alone may explain the modern interiors that have been put arbitrarily into several buildings of now outmoded style, as at the Brooklyn Museum and the Chicago Museum of Science and Industry.

Efforts to *assist* exhibits through contributory decorative means are familiar; and the results are of varying effectiveness. Membering of walls, by moldings or otherwise, to isolate objects or groups of objects on display, is an example. There are circumstances under which this helps, as on long walls with certain permanent exhibits; but in general, unbroken stretches of wall are desirable. The problem of overlong walls may be solved best by using screens of suitable design, which increase wall area while also dividing it.

Breaking of vertical height by horizontals is familiar. Painted walls commonly have a change in tone or color at 7 feet or more from the floor, but this device like the molding of old tends to be made unnecessary by reduction of ceiling height. The usual toe strip, perhaps 6 inches high, made of wood or more often of composition or stone, is an aid in maintenance apart from any value it may have as a base.

In designing exhibition space, the architect should not fail to consider both the physical requirements of the types of material to be shown and what might be called physiological, or bodily, requirements of the visitor. The latter set of factors determine the position and width of the best exhibition zone and therefore should affect exhibition case dimensions (page 237) as well as wall design.

Museum-made period settings for antique works of art are now ruled out by practically unanimous agreement among curators. Time has strengthened an opinion of long standing about this, namely, that "The museum has no need to suggest by its arrangements that which is not the fact." (Prichard in *Communications to the Trustees*. Museum of Fine Arts, Boston). Many museums, appropriately, have authentic period rooms and authentic architectural fragments used as background for related objects; but this does not justify faking of period interiors, whether looking like Gothic masonry, a Renaissance ceiling, Georgian paneling, or anything else.

It used to be maintained, in word and example, that exhibition rooms should be finished in strict neutrality, with no more in the way of color than of architectural ornament. But noncommittal gray and buff walls are now the exception, although they are sometimes adopted because the designer does not know the curator's plans or because the curator will have his own repainting done from time to time for changing installations. Colors that harmonize with exhibits are naturally sought. They may be restrained, or for some purposes they may in good taste be vivid. From room to room, different colors are employed, and there are often combinations of color within one room. Thus, the American Museum's Mexican Hall has side walls and case frames in green, end walls and floor in maroon. Pastel tints are often used; the Cleveland Museum of Art in its Colonial Room, has light blue walls and light buff ceiling; the Brooklyn Museum, in its Egyptian Hall, has blue end walls, buff side walls and case frames, white ceiling, gray floor. Richness may be sought, especially for varied exhibits; the Rochester Museum, in its central space, has deep blue walls, maroon columns, Burgundy floors. These examples are merely suggestive.

The color of rooms and furnishings should take account of lighting. Spectral deficiencies in artificial light cannot be made up with paint, because a surface does not reflect rays that it does not receive; but the color of a room can quash the most perfect lighting. Trial is the ultimate guide, but the lighting engineer can reduce experiments.

The color scheme can contribute to the architect's scheme of proportions, or it can detract. Light ceilings look higher; light walls look farther apart. The scale of a room may be reduced also by dividing the walls into two or more horizontal zones—perhaps a dado, an exhibition zone, and an upper band of such width as the ceiling, the hanging rail, and the objects on display will, among them, dictate. These factors are not always taken account of, either by the architect in the first place or by the curator later on. If a room is unsuccessful in proportion some of the trouble may be merely in its finish.

Mural paintings are found in not a few museums—Rivera's work in the Detroit Institute of Arts, Knight's work in New York's American Museum of Natural History, as two examples. In science and history museums it is usual to make mural paintings contribute to the exhibition story, as at the New Jersey State Museum with its depiction of the State's five topographies. Sometimes the building waits for many years to receive its wall paintings, but making place for murals is the planner's business.

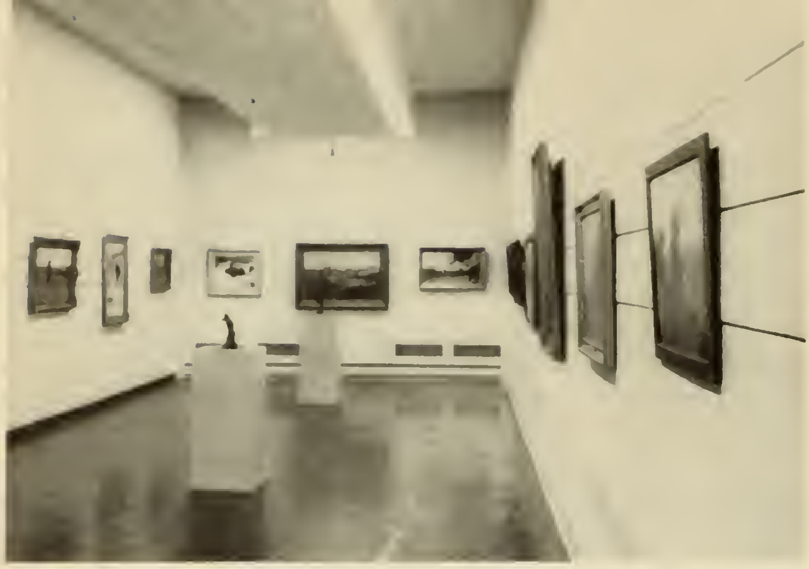
WALLS are finished in several different ways, depending on use. When pictures are to be hung directly on the wall (wires from a hanging rail now being the exception) the background material should be such as to take nails and screws without breaking down too much, and its surface should not be subject to serious marring. The usual construction for which see below, is of wood sheath covered with fabric. Ordinary plaster on cinder block has been tried, with some success.

Where objects not needing temporary wall attachment are to be shown—which means in practically all displays except of paintings and prints—a simple hard plaster finish, rough or smooth, is the rule. This surface can be renewed by patching and repainting. Paints are discussed below. Furred walls of plaster, flush with fronts of inset cases, are increasingly common.

Walls are sometimes surfaced with wood, with or without finish, for a special purpose—and this says nothing of the antique paneling in a period room, which is a part of exhibits rather than of the building. Composition boards and plyboards, in panels bounded by wood strips, are in much use too, especially for false wall, flush with case fronts. For permanent walls of greater elegance, stone is sometimes used in exhibition rooms—limestone, marble, or travertine being most familiar. But stone is ordinarily an exterior material which, if used for walls of spaces more intimate than the vestibule and perhaps the lobby, is likely to chill the spirit.

The gallery wall of wood faced with fabric is somewhat complicated to construct, but there seems to be no satisfactory substitute. Ordinarily it is made in four parts: (1) horizontal supporting strips of wood, usually two-by-fours spaced not more than two feet apart, held with toggle bolts to the hollow tile of the wall; (2) sheathing of wood; (3) a layer of impervious building paper or similar sheeting, or a coating of impervious substance processed directly onto the back of the facing fabric; and (4) a facing of burlap, monkscloth, or crash, sometimes of richer damask or rep, attached by tacking to nailing strips at top and bottom and where the cloth meets.

Many variations of this method are familiar. The supporting strips may be reduced in thickness to $\frac{7}{8}$ inch or less, and fastened by nailing to wall plugs. For fire protection the spaces between strips may well be filled with rough plaster, carried to the floor and ceiling as a seal. The wood sheathing may be of narrow, plain-edged, clear and seasoned pine boards, in two $\frac{3}{4}$ inch layers, crosslaid with the surface layer horizontal (not diagonal); or it may be in one thicker layer of horizontal boards on supporting strips running vertically; or, better, it may be of plyboard panels $1\frac{1}{8}$ inches thick, grooved on all four edges and fitted together with splines, as in the Allerton wing at Chicago. The impervious layer, if separate from the facing cloth, is sometimes put behind the sheathing to give protection from moisture as well as from dust that is breathed through any cracks and caught by the facing fabric. But coating processed



Courtesy Gilcrease Foundation, Tulsa

HANGING RAILS AT SEVERAL LEVELS ARE USEFUL FOR CHANGING EXHIBITS AND MAY CONTRIBUTE TO THE ROOM DESIGN

on the back of the facing seems to give satisfactory result; the Worcester Museum had its fabric rubber coated, at 50 cents a yard in the 1930's through F. Schumacher Company, New York, from whom only the material was purchased.

Recent developments in the use of paint over the facing fabric have tended to simplify things somewhat. Painting the fabric was at first an alternative to taking it down for cleaning—and then rehanging, only to find the material baggy. However, after some rooms had been repainted over fabric and all, museums began repainting their fabric-covered walls as part of the regular technique of installing new temporary shows; and it was then but a step to using paint at the start. This method has been so successful that several museums have put the burlap directly onto the wood sheathing as little more than texture, attaching it with glue and painting the surface at once—which makes possible the use, under some conditions, of the cheapest sack burlap instead of more costly fabrics. This does not affect the use of expensive materials if greater richness is wanted, but it simplifies many problems in less formal rooms. The Colorado Springs Fine Arts Center uses this method with very good results for some purposes.

For painting exhibition walls of any kind, a synthetic-resin-bound, water paint is best. This paint is quick-drying and has little odor. It can be applied in many coats without contraction and consequent cracking. A plain coat may be used, but mixed effects are often produced by spattering or mottling one coat over another of a different color. Considerations of brightness contrast (page 81) should guide in the choice of wall finish.

A hanging rail, in the form of a flush channel, should be provided above every exhibition wall, since objects sometimes have to be supported by wires even where other methods are usual or where no wall installations have been contemplated. The inset channel may be at the ceiling line in a room with a comparatively low ceiling, or it may be at the top of the exhibition zone in a higher room requiring a line between the zone and the upper wall. Incidentally, the slots of all channel should be stuffed with paper during construction to keep workmen from inadvertently filling them with plaster.

Several hanging rails at different levels are provided in some museums; but even though channel are set flush with the surface of the wall they appear as lines, and several of them may be objectionable. Heights of multiple rails vary. Sometimes a single extra rail is set at from 7 to 10 feet from the floor, below a top rail. Sometimes there are several extra rails, perhaps at 6, 9 and 12 feet, or 5, 7½, and 10 feet from the floor. Wooden nailing strips, set in the plaster, have been tried also; but they are unsightly if exposed, and tend to be splintered by near misses if they are covered.

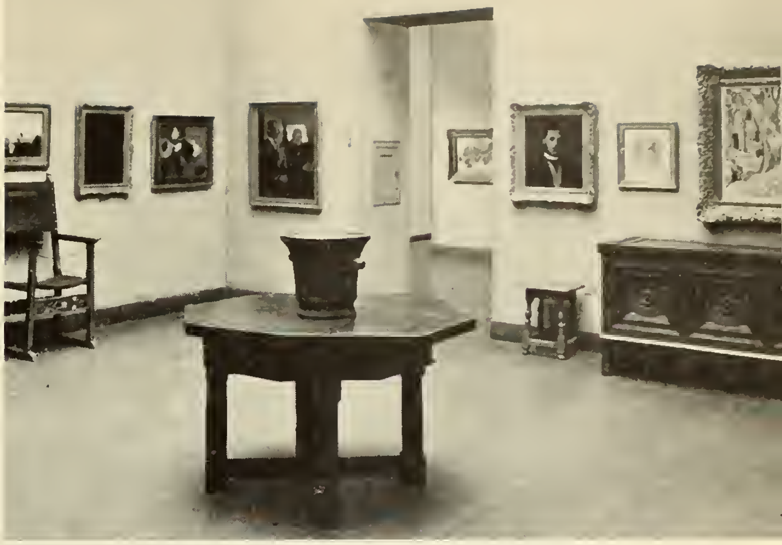
Draperies are employed in some museums as background for free-standing objects, or as curtains over elevator doors or other unsightly parts of exhibition walls. In one museum a freight elevator lobby opening on an exhibition room is draped and used as an exhibition niche.

DOORWAYS of exhibition rooms should be simple openings without any ornamental trim. Reveals may well be finished in plaster, with metal corners to prevent chipping. The reveal is the place for most light switches, and in doorways between large rooms the deep reveal can sometimes be used for panel boxes and even air-exhaust grilles in certain places.

The importance of having doorways near corners of rooms has already been noted. Axes of rooms should end on useful exhibition wall wherever possible.

The best size for doorways depends a good deal upon the kind of objects in the museum, as well as upon the size of rooms and the character of the building. Large museum objects, large assemblies such as habitat groups for which bulky parts may have to be brought from the shops, and big pieces of plate glass for any purpose make excessive demands for clearance. In the general plan of a building there should be lanes of spacious doorways leading to all main parts of exhibition space for moving of objects.

Doorways designed primarily for the use of visitors usually have a height of 8 feet. However, the type of doorway that extends to the ceiling, as though it were a space between the edges of two screens, is consistent with modern interior design and museum installation, and this sort of opening is likely to be increasingly adopted. There are good examples in the Cranbrook museums. In any case, doorways should have flat, not arched, tops—if only to assist in blocking them with barriers when necessary. The width of doorways may be 5 feet, more or less, depending upon how many openings there are to take care of the traffic and upon whether people are likely to pass through in one or both directions.



Courtesy Fogg Museum of Art, Cambridge

DOORWAYS SHOULD LEAVE AXIAL WALL SPACES FREE AND VISTAS THROUGH DOORWAYS SHOULD INTEREST THE VISITOR

Sliding doors, which disappear into walls, provide the simplest way of closing rooms for reinstalling exhibits or other reasons. Such doors may be of metal, to serve partly as fire doors. Door saddles, or thresholds, are not used in exhibition space. The floor should extend evenly from room to room.

CEILINGS of exhibition rooms are usually of hard plaster painted near-white. Ordinarily the ceiling is flat, although its form may be affected by lighting requirements. For ceiling heights see page 137; and for lighting arrangements, page 101.

Hung ceilings (page 137) are suspended on rods from beams. The rods carry a lattice of furring channel or angles supporting metal lath, wired fast and surfaced below with hard plaster.

Acoustics are not much of a problem in exhibition rooms as a rule, partly because proper flooring absorbs footfalls and partly because exhibits help to break whatever sounds there may be. However curved ceilings, as in central halls and some smaller rooms and corridors, may focus sound disturbingly. This can be overcome by use of acoustic material (page 226) if not by a change in design such as may be indicated also for totally different reasons.

FLOORING presents not one problem but many. There are such different requirements in different parts of a building that even a very small museum may require several kinds of flooring and a large museum may have several kinds in exhibition spaces alone.

The floorings of exhibition rooms should be of good general appearance and of suitable color and tone; they should be of as much softness and resilience under foot (and hence of sound-deadening properties) as their required resistance to denting and to wear will allow; and they should be as economical to install and maintain as other requirements will allow. Also they should be safe; in some museums children can slide, and old ladies often feel their way along, perhaps holding on to exhibits.

Color and tone of flooring is partly a matter of taste, taking the nature of exhibits and the desired general feeling into account. But there are also objective considerations which have to do with lighting. Glossy surfaces set up reflections. Too dark surfaces, by absorbing light, may cause contrasts in brightness that interfere with seeing; and too light surfaces may also produce excessive brightness contrast. Floors should be a little darker than walls as a rule; a diffuse reflection factor of a little more than 30 percent (see page 81) is right for most wall conditions. To illustrate: brown linoleum, with a diffuse reflection factor of about 12 percent is ordinarily too dark; whitish marble with a factor of 50 percent is too light; a mixed gray surface of terrazzo or a light and warm finish of wood may be very satisfactory. For rooms with mixed exhibits, gray floors have given especially good results. Where such floor tones produce reflections in case fronts, the trouble is with lighting.

Desire for an enlivening touch has often led to the adoption of decorative floors with gay borders, geometric overall patterns, and sometimes symbols—like the swastikas that one museum had a hard time keeping clean while the war was going on. Such embellishments take attention from exhibits, and tend to be troublesome generally.

Variety of flooring is good, and it is best achieved by change from room to room, or from one department of exhibits to another, or from lobby or court or corridors to exhibits. This gives a wide range of possibilities, as shown for example in the Detroit Institute of Arts where the following materials are employed for exhibition spaces: terrazzo, marble, slate, ceramic tile, several kinds of wood, linoleum, and concrete. These materials, together with asphalt, cork, and rubber products, are the principal floorings used in museums.

The cost of flooring varies so greatly from time to time that no dependable figures can be given. However, the relative costs of different materials are fairly constant; and recent figures show a range from a few cents a square foot for paint on bare cement floor to several dollars a square foot for some kinds of stone. Among hard floorings, terrazzo is cheaper than the tiles and stones. And among resilient floorings, asphalt is cheaper than linoleum, cork, or rubber; whereas wood runs through nearly the whole price scale according to its type. Museums use terrazzo more than tile or stone where hard flooring is wanted, although much concrete appears; and they use wood more than other resilient materials.

Floor maintenance is an important consideration. Ease, effectiveness, and cost of cleaning, and durability of the wearing surface of a flooring are factors in selection. Manufacturers provide information about this, and there is much advice in print—as in the useful booklet: *Floors and Floor Coverings* by Cornelia D. Plaister, published by the American Library Association, Chicago, in 1939.

Concrete floors, of either monolithic finish or topping finish, are low in cost and give good service; but they are hard, tiring, and noisy, and are not very good in appearance. Customarily the surface is inscribed in squares, from 4 to 8 feet on a side. It should be hardened and painted, in two coats, to prevent abrasion. Moisture makes trouble by causing eruption; but excess moisture has no place in any finished museum structure, and its effect on cement should not have to be a matter of concern. Though used throughout exhibition space in many museums, concrete floor seems more appropriate for nonpublic parts of the building which do not need other floor covering.

Terrazzo—a flooring made of small marble or granite chips bonded in a special cement, is in very wide use. This material is usually poured in place, though there is also precast terrazzo. It is separated into sections by strips of brass or other alloy, and finished by surface grinding. Durability and ease of cleaning make terrazzo especially useful under heavy traffic, as in lobbies, central halls, and corridors. It is rather noisy, but pleasing in appearance and capable of finish in a variety of ways. In a small museum it is not too tiring if used throughout public spaces, but in large museums it has to be relieved in appropriate rooms by some softer flooring such as wood. Terrazzo should not be highly polished. Where friction is wanted carborundum may be added to the matrix. Being unaffected by moisture, terrazzo is excellent for entrances, and also for toilet rooms, some kinds of workrooms, and cafeterias. Terrazzo lends itself to the special purpose of making such floor diagrams as may be required.

Courtesy Academy of Natural Sciences of Philadelphia

CONCRETE FLOORING

Courtesy Cincinnati Art Museum

TERRAZZO FLOORING

Marble, a material of beauty and durability, is much used in lobbies and corridors and for stairs, but it is not favored for intimate exhibition rooms because of its austerity, rather too light tone (or too dark in the case of certain marbles), its shininess, and the noise and fatigue it sets up—to say nothing of its top cost. It should be of uniform hardness, and should be ground but not highly polished. Unaffected by dampness, it is, however, very slippery when wet; and, though easy to keep clean, it tends to develop a gray film.

Courtesy New Jersey State Museum, Trenton

TRAVERTINE FLOORING

Courtesy Fogg Museum of Art, Harvard University

SLATE FLOORING

Travertine marble, which has a tan color and rough texture, is less formal and tends to be favored. The sound-absorbing qualities of travertine recommend it also, as much for lobby walls as for floors.

Slate is used in a few buildings—as at Cambridge, Worcester and Seattle—for courts or central halls, and to some extent for corridors. This stone, within the limits of its museum usefulness, seems to be quite satisfactory. It should have a protective coating applied at once, to prevent staining and scratching.

Ceramic tile of various kinds has found use in museums. Tile flooring, though easy to maintain, is cold and hard. Rightly it is seldom adopted for exhibition rooms. Glazed tile appears as cove bases and margins, but it does not wear well under foot. Also, tile is too noisy even for corridors; but for vestibules, wash rooms, janitor's closets, and other wet places it is very good. Ceramic mosaic, which is unglazed vitreous tile that comes attached to sheets of paper, is commonest, and is available in a great variety of forms and colors.

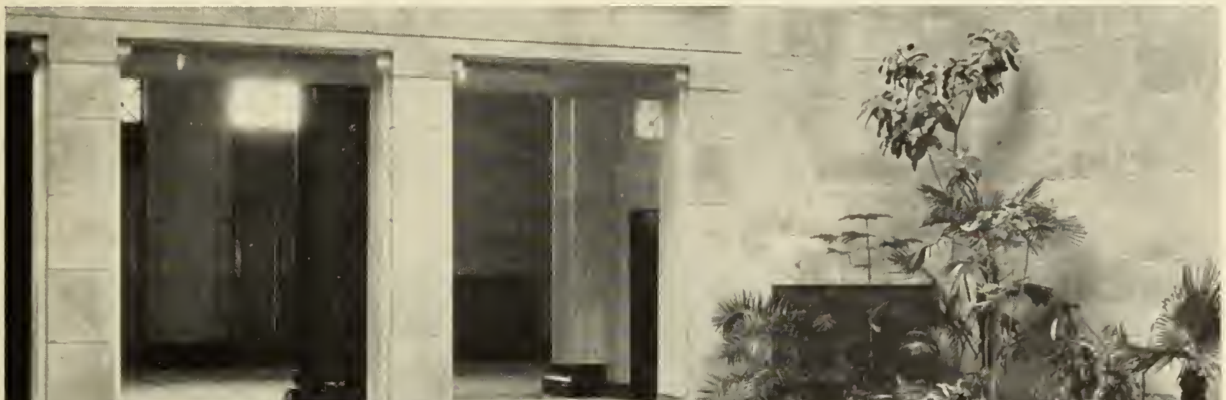
Quarry tile—unglazed tile of natural clay, sometimes with grit which prevents slipping—is especially appropriate for loggias, as it is also for treads and ramps.

Asphalt tile and flooring—somewhat resilient, easy to maintain, good in appearance, durable, and inexpensive—is an all-purpose flooring that comes in a wide range of styles. It is used in exhibition rooms, in corridors and lobbies, and in offices and other work places. Anything, from a pin to a case leg, will dent this material in time; but a tempered quality minimizes this defect at the cost of being slightly tiresome and noisy. A special advantage of asphalt is that it can be used under moisture conditions, as on a basement receiving room floor. It is fireproof, exceptionally resistant to staining and corrosion, and is not slippery even when wet. The flooring comes in rolls, and there is also an asphalt cove base on the market. For heavy duty there are extra-thick kinds, and for laying over old wooden floors there is a reinforced type of this flooring. That asphalt tile has not been used more by museums may be due partly to its hardness, partly to desire for greater richness of appearance, and perhaps partly to familiarity with early varieties of the product which had some disadvantages that are now overcome.

Cork tile and carpet are used extensively in museums. The tile, which is more durable and generally serviceable than the carpet, is found in exhibition rooms and even in corridors where traffic is not too heavy, but its commonest place is in library reading rooms and other rooms where some public use is expected and silence is very important. Public libraries employ it even more than museums. The chief advantage of cork is its softness and elasticity. It is the least tiring and least noisy of floorings, but it dents and is easily stained by oil, ink, and dirty water. It requires considerable care, even in spite of which it tends to look shabby in time. There are three shades of brown, of which the light is more suitable for exhibition rooms than the darker shades

CERAMIC TILE FLOORING, FOUNTAIN POOL AND ORNAMENTAL BORDERS IN A COURT

Courtesy Joslyn Memorial Art Museum, Omaha



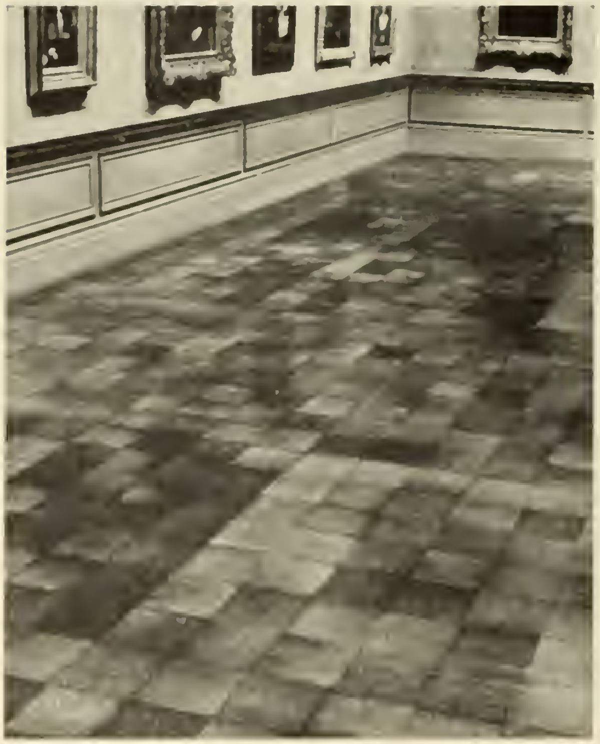
that get darker still with waxing. Cork tile is available in a variety of forms, including parquet and herringbone lay, uniform tiles of different sizes with square and beveled edges, floor boards, and cove base. A brand that serves well at Chicago is made by David E. Kennedy of Brooklyn, and is known as *Kencork*. Since cork does not become slippery, it is good for ramps; but it cannot withstand much top wetting, and must not be laid on an under surface that becomes at all damp.

Rubber tile and flooring also are very serviceable. Some museums have rubber tile in exhibition rooms, where rubber stands up better than cork and is softer than asphalt without being easily dented. This material is much more expensive than other resilient floorings, but does not seem to have corresponding advantages unmitigated by drawbacks. It is somewhat difficult to maintain. Wrong care ruins it, and the right care makes it shiny. When wet it may be slippery, and it sometimes has a pungent odor. Rubber tile comes in many colors and forms, but most of these are not appropriate for exhibition rooms. Librarians seem to regard heavy rubber tile as the best flooring for reading and circulation rooms, but museum people lean to the view that rubber is not quite right for public spaces and not cheap enough to give it much consideration for offices or other workrooms.

Linoleum is the commonest flooring in use. It is serviceable, resilient and silent, warm, cheap to install, and easy to maintain. It is obtainable in tile as well as sheets; and it comes in various colors and shades, but heavy or "battleship" linoleum, which is required for public spaces, comes only in a brown that is too dark for most exhibition rooms. Special

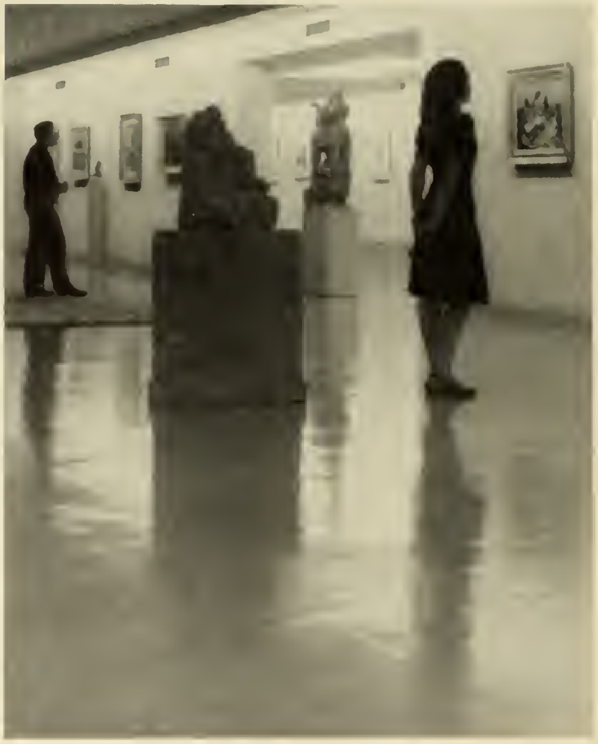
CORK FLOORING

Courtesy Art Institute of Chicago



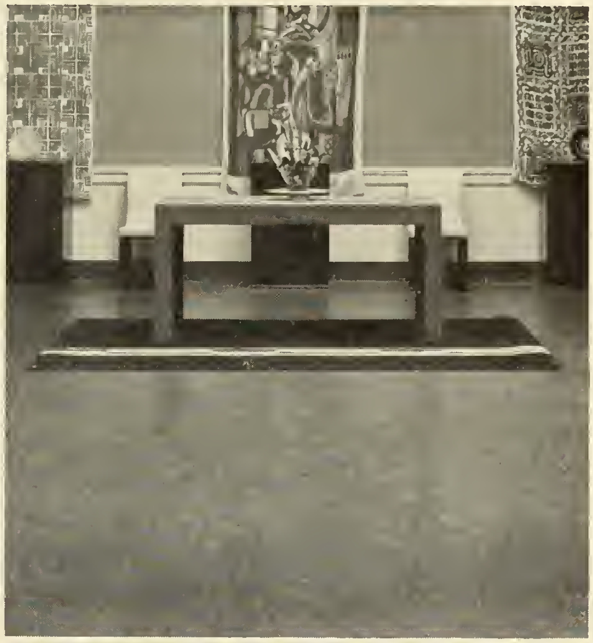
RUBBER FLOORING

Courtesy Cranbrook Academy of Art, Bloomfield Hills, Mich.



linoleums in lighter shades have been made for several museums, and some of these may later come on the market. Linoleum dents under case legs, and it does not wear as well as rubber (which is too shiny) or as well as asphalt (which may be too hard and which dents). Some museums use linoleum only in rooms without cases, or only on basement or upstairs floors, or in places where traffic is light. Nearly all use linoleum in offices and curatorial space. This flooring should not be laid on concrete floors where there is any possibility of moisture.

Wood floors—over concrete floors of fireproof buildings—are common in exhibition rooms, less common in corridors. For exhibition space wood represents a combination of virtues without a great many faults. With some kinds of exhibits, notably in period rooms, the right wood is without any satis-

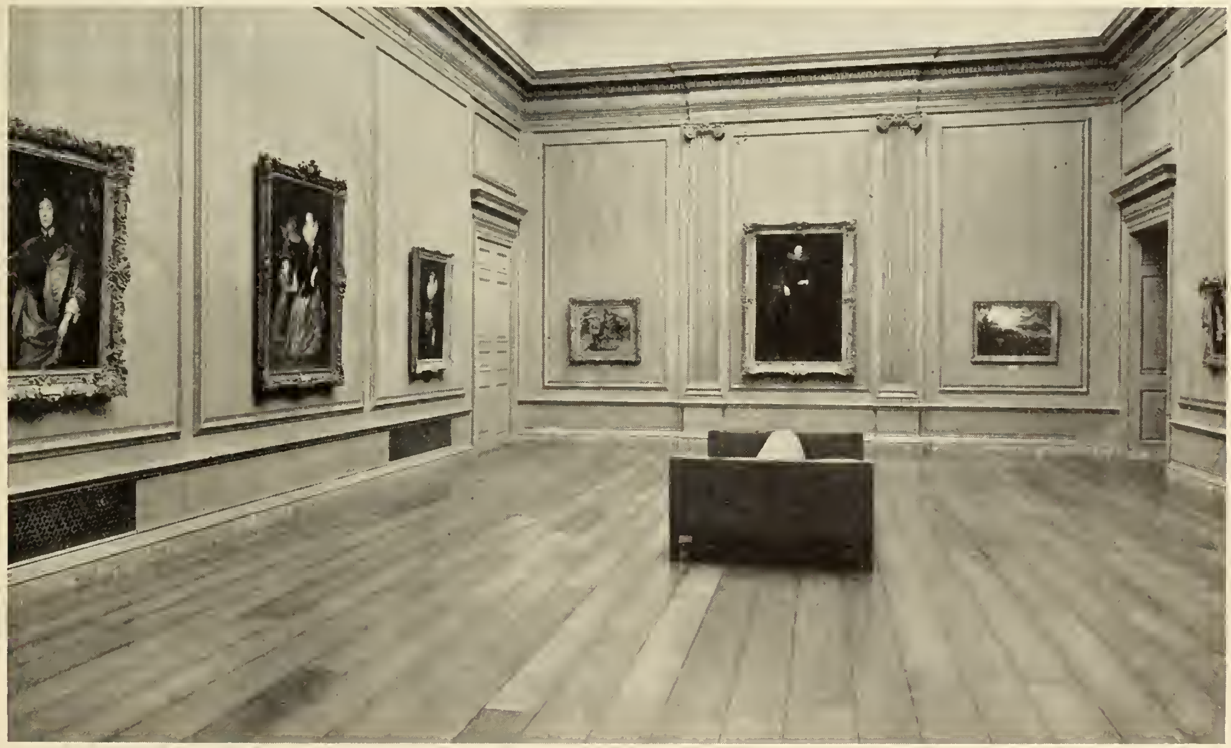


Courtesy Worcester Art Museum

LINOLEUM FLOORING

FLOORING OF OAK PLANKS—ONE OF SEVERAL WOOD FLOORINGS USED IN EXHIBITS

Courtesy National Gallery of Art



factory substitute. Though fairly hard, wood is springy and accordingly silent if properly laid. Under heavy traffic, as along lines of thoroughfare in large buildings, wood is difficult to maintain and may even wear to the point of splintering; but under ordinary demands of service it is not too much trouble to maintain, and some kinds are extremely durable. Wood does not dent under furniture, and yet—curators take note—it does not readily break friable objects set down on it. When waxed, wood is glossy and of good appearance, but it need not become slippery or too shiny. It can be selected for diffuse reflection factor in planning room lighting, and it can be depended upon to hold its color and tone. Also it is comfortably warm under foot. The cost is from medium to rather high.

Floor boards of maple, beech, birch, quartered and plain sawed oak, and yellow and white pine are familiar, and teak has been used in several art museums as at Worcester, Kansas City, and Cincinnati. Plain boards, in narrow, wide, or random width, butt-jointed, vee-jointed, or ship-lapped, are usual; but laminated planks of oak are used at the National Gallery.

Patterned flooring, mostly of oak, commonly in checkerboard or herringbone pattern, is found in scores of museums and is very satisfactory. The pieces are laid in mastic on cement floor. Steel springs are set at the margins under the wall base, in some cases, to ease expansion and contraction.

With wood, as with any other flooring, door saddles at doorways of exhibition rooms are taboo. The flooring should extend through doorways without any threshold or other unevenness in the wearing surface. If there is any unavoidable small change of level, a short ramp should be installed.

For offices, curatorial rooms, and other work places, wood is less satisfactory than some of the other resilient floorings.

Woven carpet is in some museum use, as at the Museum of Science and Industry, Chicago, where heavy pile carpet has been laid in a few of the exhibition rooms. This is an expensive flooring and is hard to maintain, but it lends variety and congenial atmosphere.

CHAPTER XII. MUSEUM LIBRARY

The library is an important museum arm for both public service and the work of the curatorial staff. It is a reference department, its books being used in the building; but also the library usually does extramural reference work by correspondence. In addition, the library may administer lending collections of lantern slides and photographs.

THE LIBRARY'S PLACE in the building is best determined by considering the two principal forces that pull upon it—that is, the demands of public convenience and of staff convenience. Public use calls for a location not too far from the entrance and under control of the lobby, and this points to either a part of the ground floor or the front part of another floor convenient to the main stairs and elevator. Staff use indicates the second floor if curatorial quarters are above exhibits, as we are forced to conclude they should be. Other locations are common, either by dint of makeshift or in keeping with some outmoded space organization. And, curiously, second-floor-front libraries are found in a few old buildings for which this position is not a good choice—as for example where the reading room is above the lobby although curatorial space is below.

Where the convenience of the director and curators has been hard to satisfy because of a location chosen in the interest of the public, special arrangements have sometimes been improvised for the staff. Several large museums have departmental branch libraries; one museum has an entirely separate research library; and one has cubicles in the library for staff use. On the other hand, some museums look upon the library as hardly more than a tool for the staff—available to visitors only on special request, and placed accordingly. But the best arrangement is to put the library in the best position considering both of its uses.

RELATIONSHIP BETWEEN PARTS of the library should be highly functional. The reading room, the librarian's desk and work place, and the bookstacks, should form all together a well knit system. In a small museum these parts may be all inside one room; but in a larger museum they are likely to have separate connected spaces, some of considerable size. In fact, the stacks may occupy a whole block.

A diagrammatic arrangement might be in the form of an unbalanced trefoil with the librarian's desk commanding the entrance at the stem. The reading room, designed to be inviting, would be the most conspicuous leaf of the clover, logically at the right as one approaches. The librarian's work place could form the small middle leaf. The bookstacks would be entered near the desk and would form the left leaf, perhaps overgrown and extending outward, upward, downward, according to the scheme of the building. The catalog should be near the desk, at the side toward the reading room. Any collection of slides or pictures with which the library is charged might share space with the stacks. There can be many modifications of this general scheme, but departures from the spirit of it should not be made hastily.

The position of the library in the building would have much to do with the bending of the diagram to fit the particular case. If the library is near the front of the building, as its proper control from the lobby would require,

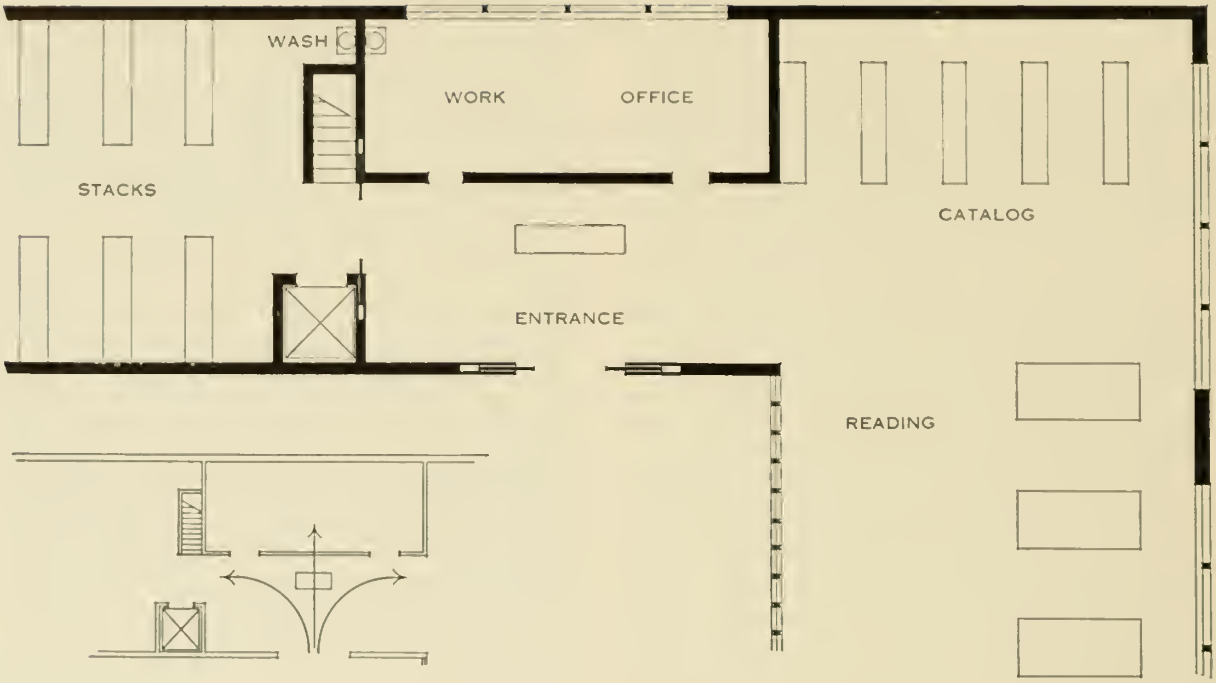


DIAGRAM OF A MUSEUM LIBRARY WITH READING ROOM AT THE FRONT OF THE BUILDING AND BOOKSTACKS TOWARD THE REAR. SECOND FLOOR LOCATION COMMONLY SUITABLE

it might be at the right side of the building (as one comes into the lobby) whatever floor it is on. This arrangement would throw the reading room toward the front of the building, and the stacks toward the rear. In a front position, the reading room is as easily lighted as are offices here. And stacks directed backward are conveniently placed for development perhaps as a vertical block that lends itself best to one side or the rear of the building.

THE READING ROOM, in its arrangements, can follow general library experience. Public libraries try to give each reader at least 25 square feet of floor space. The number of readers in a museum depends upon what the visitor can see of the library and what the public gets to know about policies as to readers. One museum with a top floor library has one or two visitor readers at a time as a rule, whereas some smaller museums with better facilities have a score or more of readers most of the time.

The reading room should be lighted by ample windows in the daytime, but natural lighting does not remove the need for adequate artificial lighting. The room should have indirect lighting for use as required, and there should be direct place lighting at each reading spot.

Flooring is commonly of linoleum throughout the library, but some reading rooms have cork or rubber. Harder floorings are a bit too noisy.

We have already noted the possibility, in some climates or perhaps in summer almost anywhere, of having an extension of the reading room to a patio, roof setback, or other outdoor space.

Courtesy Cranbrook Academy of Art

A ONE-ROOM LIBRARY WITH PROVISION FOR ADDING AN UPPER LEVEL OF BOOKSTACKS

STACKS should be standard library bookstacks. These may be placed in part of the reading room if only a small installation of shelving is required; or they may be in a separate space and arranged on two or more levels. Extensive stacks are best developed as a separate vertical unit, or block of the building, containing the greatest possible number of tiers, or levels. Library practice makes each tier 7½ feet high, putting several tiers between each two concrete floors—the intermediate floors being of steel plate, all supported by steel uprights spaced at 3 feet on centers, in ranges 4 feet 8 inches apart. Standard steel shelves are supported on brackets engaging the steel uprights and forming units, 3 feet wide, that fit between the vertical supporting members. "For the erection of multiple-story, or metal, bookstacks," says the American Library Association (*Post-War Standards for Public Libraries*) "the services of a competent engineer, experienced in their construction, are necessary." *The American Public Library Building*, by Wheeler and Githens, gives detailed technical information on this subject.

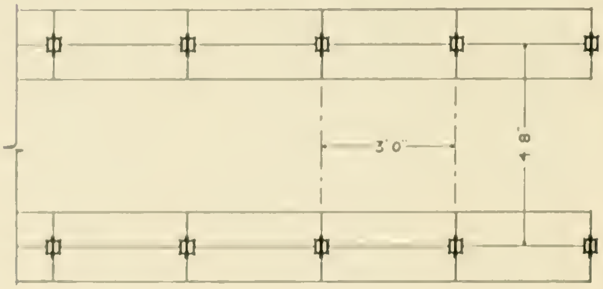
Courtesy Library Bureau Division, Remington Rand, Inc., New York

A TIER IN BOOKSTACKS SHOWING CONCRETE FLOOR WITH STEEL SHELF SUPPORTS THAT CAN CARRY FLOOR OF THE TIER ABOVE

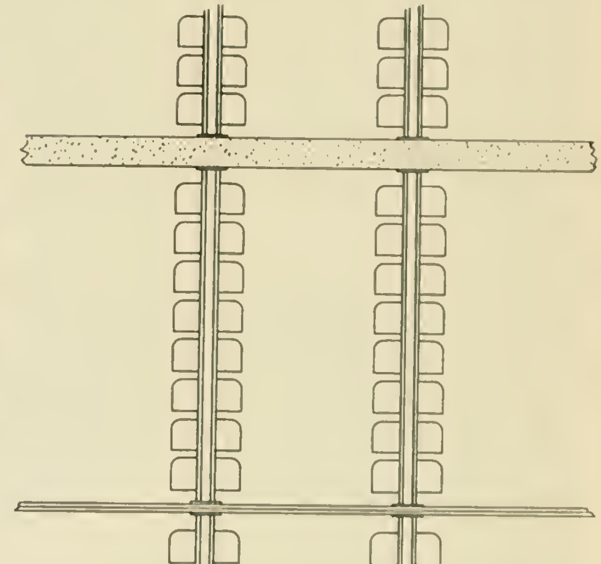
Provision for expansion of stacks is important. In a small museum there hsould be space allowance from the start, as where the reading room has one level of stacks and space above for adding other levels. And in a large museum, even one with a large separate unit of stacks, there should be an initial plan for further stack construction so that the library will not find itself at an impasse when its initial stack space is filled.

Stacks are necessarily lighted artificially throughout, although windows or panels of glass may be introduced to give token natural

SHELVES IN PLAN, SHOWING STEEL UPRIGHTS THAT SUPPORT SHELF RANGES AND INTERMEDIATE DECKS



VERTICAL SECTION THROUGH STACKS WITH SEVERAL STEEL DECKS BETWEEN TWO CONCRETE FLOORS



lighting and perhaps also to light work roosts beside the stacks. The unit should be closed and air conditioned.

Architects sometimes overestimate the capacity of stacks they design, being misled perhaps by standard library data (6 volumes per foot of shelf, 42 volumes per linear foot of range with seven shelves), which figures do not take account of the large proportion of oversize books that museums—especially art museums—are likely to have. Thus one new museum with calculated capacity of 60,000 volumes found itself with actual accommodations for only 25,000.

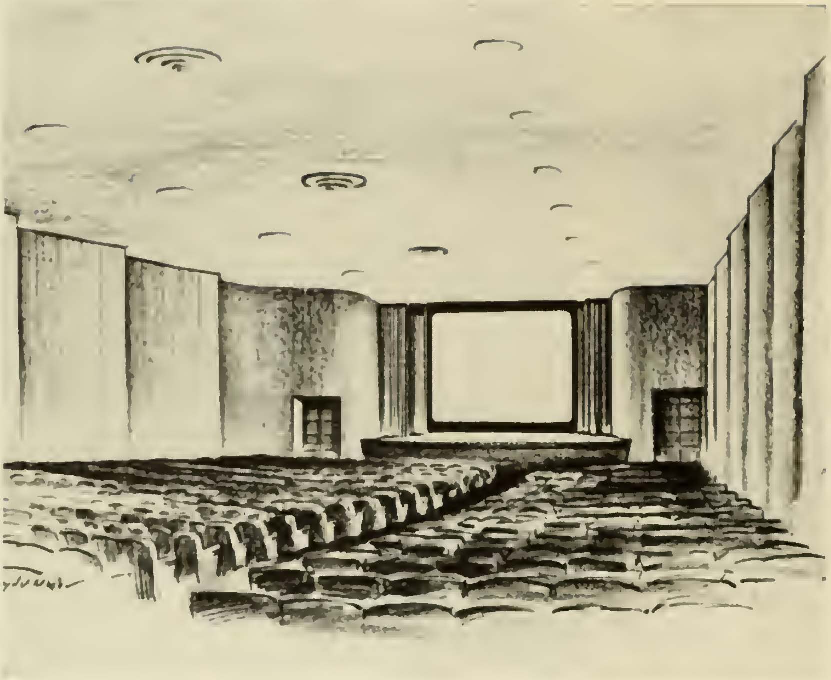
It is important to determine as nearly as possible how many books a museum is likely to acquire; and this of course depends upon many things, including the museum's field, its size, and its resources and program. In general, an active public museum in any of the first several hundred large population centers, or a working museum of a university, can very soon find itself with from 5,000 to 10,000 volumes. Almost any little museum might reach this range, and history museums are often quick to pass it. Most of the well known museums of intermediate size have not more than 25,000 volumes. Space provision for 25,000 volumes is common in all fields, and plans for 50,000 are not unusual in science and history. Museum libraries in the top bracket have upwards of 100,000 volumes and usually plan for two or three times that number. A dozen great museums—one of art, five of science and at least six of history—are in this category.

Courtesy New Jersey State Museum, Trenton

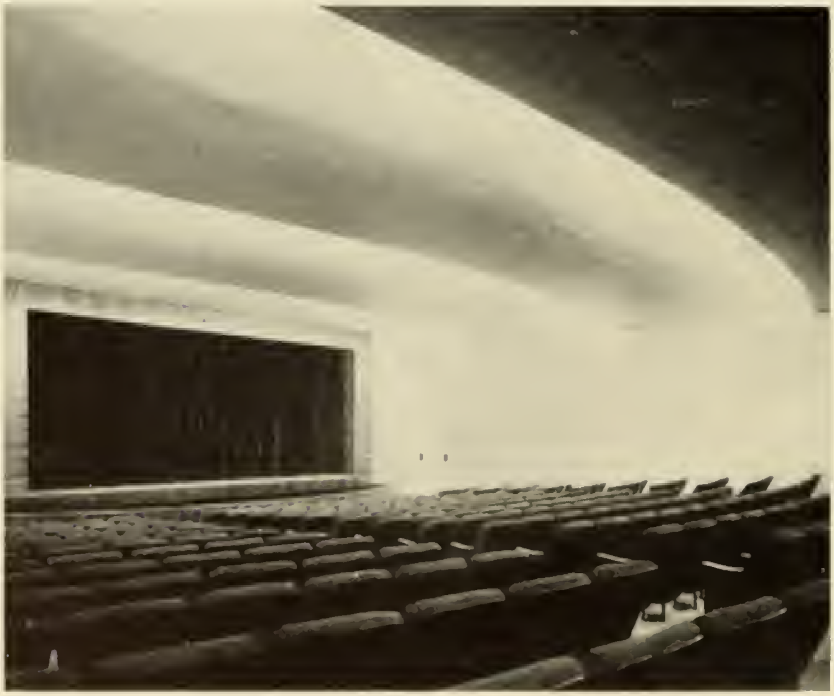
FILE VAULT IN STACKS ADJOINS FILED COLLECTION OF SLIDES AND PHOTOGRAPHS USED IN A STATE MUSEUM LENDING SERVICE

PHOTOGRAPH AND SLIDE FILES are often in the care of the library, sometimes in the care of the museum's educational division. Lantern slides are for lending, largely to teachers for classroom use. Therefore the file of slides is less appropriately a library charge than a tool of the staff concerned with school service. But the collection of photographs is mainly a reference file, and thus a natural library property. Where the library has charge of either of these collections, the space set aside for the required filing cabinets may well be situated as though it were kindred to the stacks rather than to the reading room, but it should not give all comers easy access to the bookshelves.

The size of the place provided should take account of likely growth of its collections. Provision for 5,000 photographs and 5,000 lantern slides might be only a beginning in an active museum, however small; and provision for 25,000 photographs and 25,000 slides might not long be excessive. Some large museums contemplate having 250,000 photographs and 50,000 slides.



AUDITORIUM AS PLANNED FOR PROJECTED INDIANA STATE MUSEUM, INDIANAPOLIS, INDIANA



AUDITORIUM IN BASEMENT OF AVERY MEMORIAL, WADSWORTH ATHENEUM, HARTFORD, CONNECTICUT

CHAPTER XIII. ASSEMBLY ROOMS

MANY ACTIVITIES, educational and recreational, call for provision of assembly rooms in museums. Lectures, musical programs, motion pictures, dramatic performances, public meetings, and other occasions for the gathering of sizable audiences are in the regular line of museum business. Practically all public museums have at least one lecture room, or its equivalent in space that can be used for seating groups. Some of the larger museums have two auditoriums of different sizes, or perhaps a lecture hall and a theatre or concert hall. In addition, most museums have smaller rooms for the use of classes, clubs, and other small groups, as we shall note in the chapter that follows.

THE AUDITORIUM, or lecture room, is designed as a rule primarily for illustrated talks and motion pictures. It presents problems of size, location in the building, interior design, and equipment.

The largest places of assembly in museums (not counting several vast assembly halls that are only associated with museums, as at Pittsburgh and San Francisco) are the concert halls of the Toledo Museum of Art (seating 1500) and of the Joslyn Memorial, Omaha, and the theatres of the Detroit Institute of Arts and the Art Institute of Chicago (seating 1200 each). The largest true lecture halls are those of the Chicago Museum of Natural History and Museum of Science and Industry (1200 each), and of the Denver Museum of Natural History (1000). Somewhat smaller halls, seating 500 or more, are found in a dozen museums, most of them in cities of more than half a million inhabitants; however, the Toledo Museum of Art, in a population of a quarter million, has a hall for 850, in addition to its larger concert hall. Smaller halls taking less than 500 are numerous; at the Joslyn Memorial there is a lecture hall for 325 and three smaller meeting places, in addition to the concert hall. Meeting rooms that seat say 100, or space designed to take about that number of folding chairs and perhaps a sectional platform, are found in even the very smallest museums.

The size of the community may give some indication of auditorium seating requirements; but in this, as in museum attendance, small places show up proportionately better than large places. Thus, at Pittsfield, Massachusetts, there is one seat in the museum lecture hall for every 200 inhabitants; whereas at Boston there is one seat in the art museum lecture hall for approximately every 2,000 inhabitants; and in New York each of the big museums has a seat for every 16,000 New Yorkers. For places of intermediate size (populations between 500,000 and 100,000) an allowance ranging from one seat per 1,000 to one seat per 500 would not be excessive. This means seating capacities from 500 to 200, as shown by the table below.

Museum	*Population*	*Seats*
Minneapolis Institute of Arts . .	492,000	695
Minneapolis, Museum of Natural History	492,000	470
Cincinnati Art Museum	456,000	450
Columbus Gallery of Fine Arts	306,000	340
Dallas Museum of Fine Arts . .	295,000	300
Hartford, Avery Memorial . . .	166,000	300
Grand Rapids Public Museum .	164,000	240
Reading Public Museum	111,000	200

No rule should be followed blindly, however. Much depends on the museum's work, as seen by the fact that in Rochester (population 325,000) the active Museum of Arts and Sciences, which has an auditorium seating 230 and a central exhibition space that can take 1000 chairs, is still in need of a hall that will seat 2000.

The questions of where the lecture hall should be in the building, and of relations between the lecture hall entrance and the main museum entrance have been discussed (page 124). It is essential that the assembly hall be usable without opening other parts of the museum. The belief that exhibits should always be open to lecture crowds is not supported by experience generally. About the *least* advantageous arrangement seems to be that of having the lecture hall straight ahead as one enters, occupying space that belongs to exhibits if it is not used for orientation.

The lecture hall lobby and its service facilities are also discussed above (Chapter IX). Where one set of toilet rooms does for both the museum lobby and the lecture hall lobby, the arrangement should not defeat the possibility of complete separation of the lecture hall from other parts of the building. The lecture hall checking requirements are greater in proportion to the size of the crowd than the requirements at the main check room of the museum, and are likely to be from 50 to 75 percent of the lecture hall capacity. Large auditoriums usually have separate check rooms for men and women, each check room near one of two retiring rooms. Toledo has two little lounges also each near a check room, with its toilet rooms below. For small lecture halls, there may be only one check room, preferably with a long counter so that several lines can form when the load is at peak.

If the auditorium lobby has no secondary use and must therefore be idle when the lecture hall is not busy, there may be temptation to make it too small for its ordinary purpose. However, in several buildings the lecture hall lobby is planned for use as an extra meeting room, with modest projection facilities of its own in one museum. Some museums have planned this space for temporary exhibits that can be open at all times.

The lecture vestibule and doorway deserve to be planned with reference to the probable maximum crowd, and arrangements toward weather protection from curb to vestibule are also important. Where the direct entrance to the hall is at the right or left of the main museum entrance, one long roof slab might cover a sidewalk or low porch serving both portals. This would give space for several cars to pull up at once and discharge their occupants under cover.

There should be a small box office at the lecture hall's direct entrance, if only for use when the hall is taken by an outside organization.

The auditorium proper should be like a good hall of this kind anywhere. It is at best an unbroken space with width somewhat more than half the length. What to do about supporting columns which obstruct vision is a common problem with auditoriums of considerable size. Where the overhead load is rightly distributed, heavy spans across an auditorium may serve without intermediate support. Thus, at the Avery Memorial, Hartford, a wide central span is produced for the auditorium in the basement by widening the court above and using cantilever construction for balconies around the court from the second floor up.

The floor of the lecture hall may be level or pitched, depending upon what uses of the space are allowed for. A level floor with portable chairs gives a room of possible usefulness alternatively for receptions and perhaps even exhibits; but a pitched floor means a room that might as well be fitted out with fixed seats and the other specialized appointments of an auditorium in any setting. There should be soft flooring (page 154), acoustical

Courtesy Minnesota Museum of Natural History, Minneapolis

LECTURE HALL HAS OWN ENTRANCE AND ANOTHER FROM LOBBY
C. H. JOHNSON, ARCHITECT; ROY JONES, ADVISORY ARCHITECT

treatment (page 226), air conditioning (page 204), and special lighting arrangements.

Lighting must be under ready and complete control, which means that it should be entirely artificial. Audiences expect this; people are not always at ease in a hall with windows—which, by the way, is a good illustration of how largely our reactions to lighting are matters of habit. Indirect general lighting of the hall is usual, and one of the best ways of providing for it (and for good acoustics as well) is by a scheme of nonparallel walls and sloping ceiling in acoustical plaster, with overlapping coves above or in the sides or both, as at Baltimore, Hartford, Rochester, and elsewhere. But museums show also many a rectangular room of good auditory and visual properties. Warm color schemes have been favored in recent buildings, as at the Museum of Modern Art.

Seating arrangements must meet the requirements of building laws, which specify the distance between rows of seats (ordinarily, 32 inches or more from back to back), the number of seats in a row (ordinarily, 14 at most between two aisles, or seven at most between an aisle and a wall) and often other particulars. Experience shows that not more than a dozen seats between aisles and not more than three seats next to a wall are better than the full allowances of law. The usual spacing of seats in a row is upwards of 20 inches between centers. For small lecture rooms a two-aisle arrangement is good, and a one-aisle arrangement is bad as a rule unless the aisle is off the longitudinal axis of the hall as in the project for the Indiana State Museum. In larger auditoriums a three-aisle plan, or better a four-aisle plan, with the side aisles at the walls, is usual. Aisles are from 3 to 4 feet wide in a small hall, wider in a large hall. A floor plan that tapers to the front avoids the difficulty of having almost useless seats in the forward corners. To calculate very roughly the maximum capacity or the minimum required size of a room, an allowance of seven square feet to a seat covers aisles and a modest platform. In some recent buildings the rate is from 10 to 12 square feet per seat.

Arrangements for adjusting the room capacity by means of folding partitions and extra blocks of seats at the sides of the hall have been considered in the planning of several buildings; but apparently not one of these plans has been carried out—and wisely so, it would seem. However, folding partitions between units of classroom space may be advantageous, as we shall see.

Fixed chairs of theatre type, comfortable and of a good appearance, upholstered in leatheroid material and not drab in color, are increasingly the rule. Museum architects stress the importance of comfortable auditorium seats. However, many little lecture rooms—especially those of very small museums—are equipped with folding chairs.

Exits must be provided in accordance with building law requirements. Wherever doors equipped with panic bolts lead directly to the outside, there is the difficulty that such exits may add to the danger of thefts from the museum. To overcome this, some auditoriums give at the sides onto ample passages which in turn communicate with the regular channel of coming and going. An open court, forming part of this system, can be used as a promenade. But no matter what the plan of exits, the problem emphasizes the importance of having the auditorium capable of being cut off from other parts of the building.

The fireproof projection booth is an underwriters' requirement for showing of standard (35 mm.) motion picture film, and is therefore an essential. It should have projection equipment for both 16 mm. and 35 mm. sound film and for lantern slides. For continuous projection of 35 mm. film, two machines are required; but for the much longer reels of 16 mm. film one machine is sufficient. One sound panel will serve both of the larger machines if they are matched as they should be; also a panel is required for the single smaller machine. The projector for standard 3 by 4 inch lantern slides should have an adapter to take 2 by 2 inch Kodachrome slides, and there may well be provision for double projection. Each projector has its own protected porthole in the front of the booth, and there are also observation ports. Booth appointments should follow fire underwriters' standards. The booth should be spacious and well ventilated. It may well have doors to both the auditorium and the auditorium lobby; and the doors should have strong locks. Some museums have projection equipment fastened in place, if only to thwart would-be borrowers. The booth should have a two-way telephone connection with the lecturer's desk.

A separate vault for film storage is desirable. This provision is affected by special underwriters' requirements as to construction and sprinkler protection.

The platform or stage, in most museums, is arranged for lectures and motion pictures only; but some museums have the stage fully equipped. An equipped stage can be used for educational activities as well as for music and dramatics. The Grand Rapids Public Museum, though not devoted to art, is about to make provisions for the local dramatic society as a natural part of its community work. The stage of Detroit's theatre, as of several others, has a regular stage loft and all needed theatrical lighting installations. At Pittsfield, where the recently remodeled auditorium provides for "every sort of presentation likely to be given before an audience limited to 270 people," there was no room for a fly gallery; but large wings and lighting arrangements for little theatre groups were provided. The Toledo Museum of Art can accommodate the largest symphony orchestra or choral body in its concert hall; and arrangements in many a smaller museum can meet most concert needs. Even where there is only a platform, there may well be facilities for getting in a concert grand piano, and also for putting it out of the way in a wing.

Platform equipment, save perhaps in very small rooms, should include connections for signals, besides the telephone connection, to the projection booth. There should be a voice amplifier. In the auditorium of Cincinnati's new Alms wing there are some connections for hearing aids as well.

As to stage lighting, Architect Robert B. O'Connor writes of the Pittsfield museum's equipment: "A new type of switchboard was installed which has various advantages over previous switchboards, especially for stages adapted to use by little theatre groups. An interchangeable plugging system makes it possible to put any circuit or combination of circuits onto the dimmer control. Because the dimmers are on the reactance principle rather than the resistance principle, they do not have to be balanced for each individual load as was formerly the case. Furthermore, this board is so constructed that the working lights normally required for the use of the auditorium are on ordinary switches so that the dimmers can be locked and thus removed from the damaging experimentation which so frequently occurs on semi-professional stages."

A few science museums have the platform equipped for laboratory demonstrations, and opaque- and micro-projection. It must not be forgotten that table demonstrations require all seats to *look down* on the lecturer's table. For ordinary purposes, however, a platform that is two or three steps up from the floor at the front of the hall is satisfactory.

Backstage facilities follow naturally from the character of the stage. Dressing rooms and toilet rooms are required for theatrical performances; but museums, understandably, are not much developed along this line. The Columbus Gallery of Fine Arts has an ingenious backstage arrangement that puts its dressing rooms where they can be used alternatively for other purposes. The Avery Memorial has free space, communicating with the stage, that can be adapted to dressing-room and other requirements. Some such plan seems especially good for a small museum. The Joslyn Memorial, Omaha, has a spacious "green room" behind the stage, along with some other facilities.

THE PLACE FOR MUSIC in a museum may not be the auditorium at all. In good weather it may be a patio or other outdoor space, or at any time it may by preference be an indoor garden court. A quarter-century ago, the Cleveland Museum of Art discovered the value of its garden court for organ recital audiences, and others have since followed the example. For the past several years the National Gallery has been using its garden court for concerts and recitals, partly because the attendances (500 to 1000) are too large for the lecture hall, and partly also because of the court's agreeable atmosphere. The Colorado Springs Fine Arts Center, which has a special room for recitals, and the Toledo Museum of Art and the several other art museums with impressive concert halls, are under less temptation to seek casual settings for their musical programs; but most museums have a music problem worthy of ingenuity. There is abundant evidence of this in the variety and importance of musical presentations in scores of museums, as reflected regularly in the music columns of *The Museum News*, and in the fact that many museums have excellent pipe organs—art museums of Cleveland, Dayton, Detroit, Omaha, San Francisco, Toledo, and Worcester, and the science museum of Rochester.

A museum garden court should certainly be planned for music. A lecture hall of good size and congenial atmosphere is not the less needful because there is a garden court; but, regardless of lecture hall, any garden court had better be arranged for public gatherings,

MAIN ENTRANCE COURT HERE IN TEMPORARY USE FOR MUSICAL PROGRAM WITH TYPICAL ATTENDANCE

Courtesy Worcester Art Museum

NATIONAL GALLERY ORCHESTRA USES GARDEN COURT FOR ITS WEEKLY CONCERTS

not solely for plants and strollers. The court—by makeshift if not by forethought—is an assembly room.

How to provide a satisfactory garden court is a question that may well intrigue building committees and architects. Now that courts in the modern spirit can take the place of formal courts, such as were appropriate in buildings of older types, there is a chance to design creatively for practical as well as aesthetic ends. The accustomed geometry of gravel beds and paths that leave little space for chairs, and the familiar profusion of columns and other features that interfere with seeing and hearing are of the past. A modern garden court would be planned to give a clear view from all points and also to have the best possible acoustics. Part of the court would be designed to serve effectively as a stage, with adequate backstage facilities. Other parts of the court would be studied for seating—to provide for chairs or for use of mats on terraces, or perhaps for seating directly on steps of material that is not too cold. Also there would be studied areas of rightly chosen greenery so laid out that the whole audience would be able to see the stage. The court could be a thrilling place of utility, without prejudice to its being at other times a delightful place for strolling and repose. Such a piece of designing has not yet been done; but when it is done, very wide notice will be taken of it.

Lighting of a garden court should be natural by day, with some sunlight let in for the plantings. It has been suggested that in favorable climates a rolling skylight might be appropriate. Such a skylight at the Pan American Union in Washington, D. C., is highly satisfactory, and has as its only special demand that there be a ten-minute start on a shower for closing.

CHAPTER XIV. EDUCATIONAL DIVISION

Educational space can be said to embrace the entire museum building, taking in more particularly the exhibition space, the library, and the auditorium. But the educational department, often so called, has specific physical requirements in addition to these outlying provinces—requirements that may find expression in a suite of rooms for instruction, studio and laboratory work, care of the lending collection, and the administration of the department itself. Even in very small museums there is provision for such work.

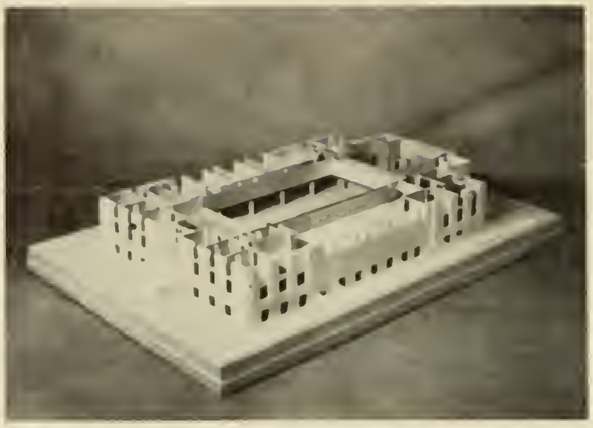
THE DIVISION'S WHEREABOUTS, in a building of some size, depends upon whether visiting classes will use the main entrance or will have an entrance of their own. A separate basement entrance for the children has some obvious advantages, but this doorway may be difficult to supervise and its presence may demand that educational space be cut off from other parts of the building, which is not good for the work of the division.

Where children use the main entrance the problem is whether to put classrooms on the entrance floor, or one floor up or down—more than one floor up being impracticable in the absence of an elevator as big as Noah's Ark. Ordinarily the entrance floor, which should be the main exhibition floor at ground level, does not afford space enough for classrooms. The floor above, which may be an exhibition floor also, is strongly claimed for at least a part of the curatorial space. The basement—if freed, as it should be, of curatorial use and of the library and business offices—should have space that lends itself naturally to educational rooms. But at Rochester, as we have noted, the educational space is on a mezzanine floor consisting of a circuit of rooms around the upper part of the ground-floor's central exhibition space.

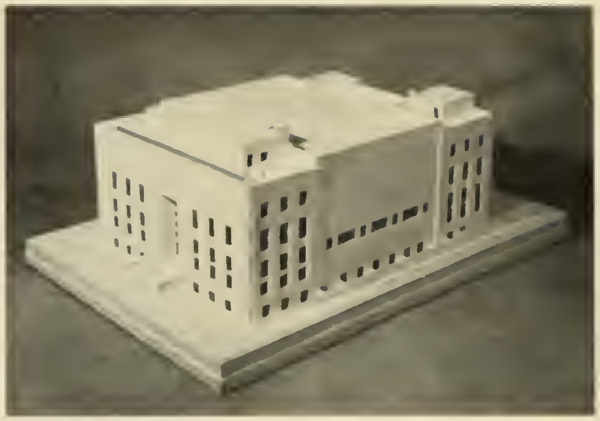
The educational division, at whatever level, should be easily accessible from the lobby by way of a free passage. Where this route must ascend or descend there should be an ample stairway, leading to the right or the left; and this should be placed for ease of supervision from the information desk. If it can branch from a passage leading to the lecture hall, certain advantages are gained; the hall may then be used conveniently for groups that would overflow classrooms, and also the lecture entrance may be used for class visits if so required. There does not seem to be any museum with precisely this simple arrangement.

Although having special rooms for instruction and practical work is very important, it should not be forgotten that some part of group instruction must extend into the exhibition rooms and that ready access to the exhibits is important too.

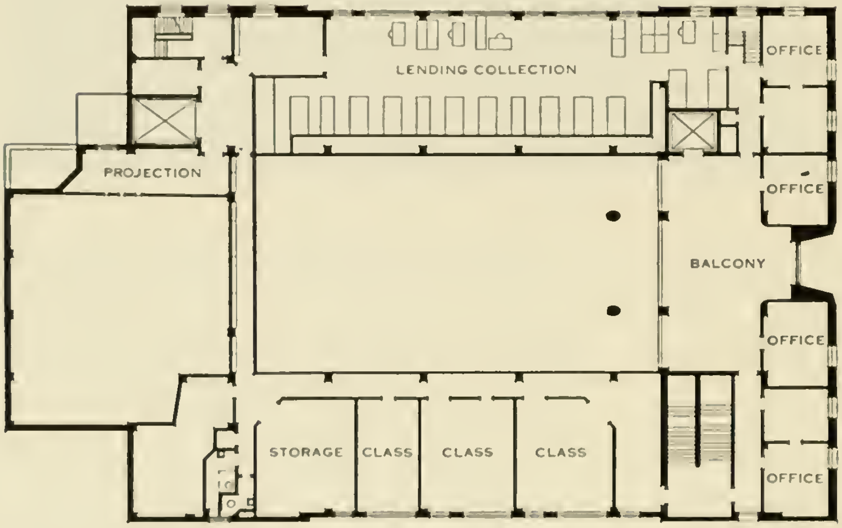
The amount of space required depends of course on circumstances. Good examples of consolidated educational space in large art museums are seen at Philadelphia and Toledo—the former with upwards of 10,000 square feet in use, not counting an auditorium and space reserved for expansion. Toledo's quarters are larger, being a variable part of extensive art school quarters. The best recent example in a science museum is the educational mezzanine at Rochester with about 6,000 square feet, including space for the lending collection. These notes pass over certain large-scale provisions—the greatest of them, already noted, being the American Museum's entire building designed expressly for school service.



EDUCATIONAL QUARTERS OF ROCHESTER MUSEUM ON MEZZANINE FLOOR, SHOWN IN A SCALE MODEL



ROCHESTER MUSEUM OF ARTS AND SCIENCES MODEL KAELBER AND WAASDORP, WENRICH, ARCHITECTS



(LEFT) ROOM ARRANGEMENT IN EDUCATIONAL QUARTERS ON THE MEZZANINE FLOOR OF THE ROCHESTER MUSEUM OF ARTS AND SCIENCES

(BELOW) CLASSROOMS AND STUDIOS IN SPECIAL WING OF DALLAS MUSEUM OF FINE ARTS, ROSCOE DEWITT AND ASSOCIATES, ARCHITECTS

CLASSROOMS AND STUDIOS are essential to museum work, and are provided in number and character according to the size and needs of the institution. Where there is a well developed art school in the museum there must be suitable studios for painting, sculpture, and other arts and crafts. But apart from these requirements, every museum—even the smallest—needs at least one room, or its equivalent in available space, for instruction of classes—and alternatively for use by other small groups—as well as space for laboratory, studio, or shop work. Scores of museums have quite impressive facilities of this kind. Toledo's educational suite has a dozen rooms that can be used to seat from 40 to 150 people. The Philadelphia Museum, as noted above, has five or six rooms, some of them appointed mainly as studios, others mainly as classrooms. The projected addition to the Grand Rapids Public Museum includes a space to be variously divided by folding partitions. Separate rooms for children and adults are much to be desired if there is space enough for this. Studios used in the afternoon by children and in the evening by adults are never quite to anybody's taste, in their arrangement or the many evidences of use. Few museums may be able to provide in this way, but any museum can have rooms that are capable of being kept shipshape.

Equipment of classrooms and meeting rooms should be simple and flexible. Folding chairs are best, and there should be a place for storing them perhaps piled in rolling dolly racks. Any required tables should be of knock-down construction. There should be a blackboard. Shelving all around, up to desk height of 30½ inches, is useful. Cupboards should be recessed and should have flush doors. Any radiators are at best recessed under windows. Natural lighting by windows at the side—never at the front—of the room, and semi-indirect artificial lighting are required. There should be tight-fitting, opaque shades. The lighting circuit should include a dimmer. Walls should be flat and unbroken by juts; even doors may be flush with walls to give added plain surface on which to hang charts and the like. Walls are conveniently finished in a material such as composition board to take thumbtacks, and should be painted to give a surface suitable for projection. Flooring of linoleum is satisfactory.

A SEPARATE SMALL BUILDING NEAR MAIN BUILDING PROVIDES FOR CLASSES. SANTA BARBARA MUSEUM OF NATURAL HISTORY

Studios, whether for regular art school work or for manual work attendant on group instruction, are like specially equipped classrooms. They should be fairly compact, not long and narrow. If possible they should have north light. Windows should be large, extending to the ceiling; and in a structure that permits, they may well be canted toward the sky. Each studio requires the provisions suggested for classrooms, and in addition a studio requires a monel metal or soapstone sink with a plaster trap in the drain. Asphalt flooring is good, but linoleum will do.

Accessory rooms may be needed. These should include special toilet rooms if there are many children using the educational suite. School classes require some kind of cloak room; an arrangement that provides a hamper for the hats, coats, rubbers, skates, and other trappings of each class is good if attendance is large. Locker rooms are needed for art students. And perhaps it should be noted here that many art schools lack a place for work on large objects.

THE LENDING ROOM is the visual-aids center and distributing place. Here teaching material is made ready, and from here it is lent to teachers and perhaps transported to schools. Lantern slides, photographs, and graphic reproductions are commonly lent by the museum library; but apart from this most museums do some lending of bulkier objects, and many public museums have a special place for such effort, while those with very active services have lending quarters with stock rooms, special shops, offices, and perhaps trucking facilities. This line of work is most extensively practiced by science museums, although not a few art museums also have the work well developed.

Because of the constant going and coming, loading and unloading, of material in the lending collection, the lending room may well be near the shipping entrance. Where the educational division as a whole is in the basement, a natural scheme of horizontal flow should be easy to lay out; but where the lending room is on a floor above, as at Rochester, the freight elevator must connect this room with the shipping room below.

The lending room should have space for counters and other handling arrangements, flanked by banks of open shelves. Here a ceiling height of not more than 8 feet is advantageous, since this precludes high shelves that call for use of a ladder and may lead to falls. Objects and carrying cases handled in this room are of predictable sizes and shapes, and the shelving should provide for them. A fully fireproof vault is required for film.

LENDING COLLECTION ROOM FOR SCHOOL SERVICE OF ROCHESTER MUSEUM OF ARTS AND SCIENCES

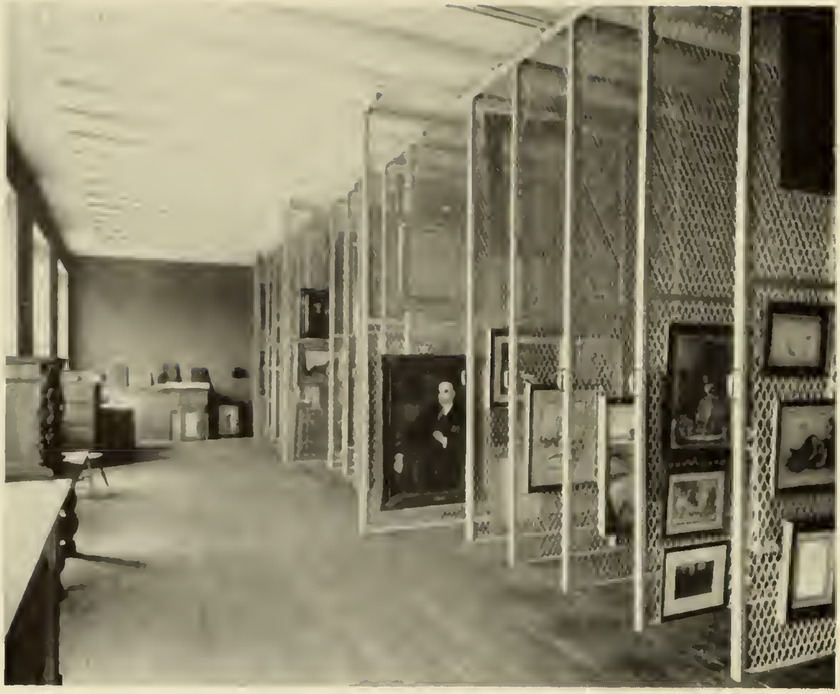
FILM VAULT AND SHIPPING ROOM OF VISUAL AIDS BUREAU, NEW JERSEY STATE MUSEUM, TRENTON

Certain working arrangements can be made in advance. The lending room needs at least a work bench, perhaps a small shop of its own. One end of the room—the end that individual borrowers approach, coming by way of the public entrance—should be cut off by a counter so that visitors do not have access to the work space. Outside the counter there should be space for an index of material for the borrower's use, and arrangements for waiting. There may also be space for display of simple material. Just inside the counter is the place for an office corner. Regular shipments do not pass here, but go out at the other end; and it may be found advantageous to arrange for checking messengers in and out at the shipping entrance also, to avoid their carrying objects through the lobby.

JUNIOR MUSEUM SPACE within the public exhibition space of the museum, though not new, has become familiar of late through several examples. At the Metropolitan Museum, for instance, several galleries near a secondary public entrance have been remodeled to give a suite for the use of visiting school classes. In addition to exhibition galleries, this Junior Museum has a library, a motion picture theatre seating 160, a lunch room in which classes coming with their teachers can eat their package luncheons, and the necessary checking and wash rooms. The American Museum's building for school service has long kept its exhibition room busy with various displays and fairs of interest to children. Even some rather small museums have similarly set aside space. And Kansas City's Nelson Gallery has run its museum-within-a-museum under junior management.

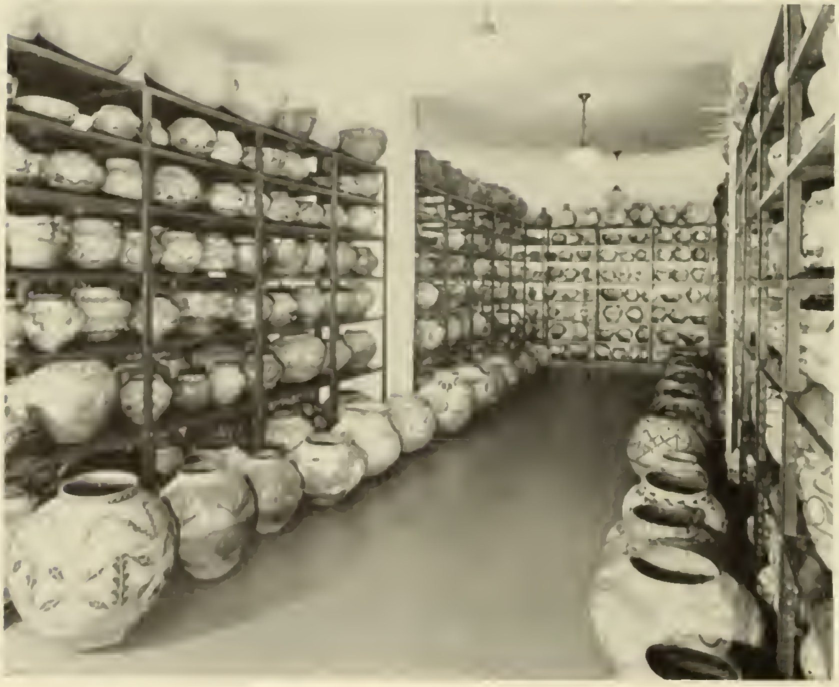
THE NEW NATION SURVIVES
1
TRAVEL IS SLOW AND DIFFICULT

IN JUNIOR MUSEUM QUARTERS SPECIAL EXHIBITION TRACES AMERICAN HISTORY
Courtesy Metropolitan Museum of Art



STORAGE AND STUDY ROOM FOR PAINTINGS COLLECTION

Courtesy Fogg Museum of Art, Harvard University



ANTHROPOLOGICAL STUDY MATERIAL IN LIVE STORAGE

Courtesy Laboratory of Anthropology, Santa Fe

CHAPTER XV. CURATORIAL SPACE

Growth of collections, during the past half century, has been met as a rule by adding single-mindedly to exhibition space. This response to pressure has often been carried so far that exhibits have become disjointed and buildings have suffered in usefulness. However, during recent years museums have turned to another way of expanding, namely, by enlargement of curatorial space for the care and use of collections *not* on display. This change improves the quality of exhibits by allowing for selection; it provides for adding quantities of material without the attendant effect of being bogged down in a glut of possessions; and it makes for ready exercise of the museum's powers.

LIVE STORAGES, often called *study storages* because they make collections available for reference work and research, are essential to full development of a museum. They form the largest part—or potentially the largest part—of curatorial space.

Science museums were the first to practice study storage in a serious way, and they have steadily increased the proportion of curatorial to exhibition space in their buildings. Thus, the oldest wings of the American Museum (1877 to 1909) have one floor of study-storage space and four of exhibits; whereas the later building of the National Museum (1911) has two floors to two; the Chicago Natural History Museum (1921) originally had more than two to two; and new units of the American Museum (1935) have something like five to two—showing increase of curatorial space, largely for live storage, from 20 to about 70 percent. Although the proportion of curatorial space reflects the work of the individual museum, science museums generally now tend to have as much curatorial space as exhibition space.

Art museums, on the whole, have not made satisfactory provision for reserve collections, partly because in the past art collections have been relatively small and have had little study and reference use. But largely it is because the widespread employment of skylights has kept art museum buildings from being developed above exhibition levels, and has forced storage space into otherwise crowded basements where proper curatorial arrangements can rarely be made. In the teeth of this difficulty, Cleveland built a large, artificially lighted, ventilated storage room under its garden court. This scheme has been followed or improved upon in several later museums, as at Seattle where a long range of curatorial space was introduced along the front of the half-basement, and at Worcester where roomy storages for paintings, furniture, and other materials were placed under the central area of the latest building. A related special arrangement, not ordinarily possible, was made in the Radeke Building (1925) of the Rhode Island School of Design's Museum, which has storage rooms for several departments on two floors below street grade but above ground at the rear. The Frick Collection has blasted itself a four-story, air-conditioned vault reaching 45 feet down in the bedrock of Manhattan. In a number of recent buildings, including the National Gallery of Art, from a quarter to a half of the ground floor has been allocated to storage. But it remains for the future fully to establish the principle that curatorial space should be planned *for expansion*, whether upward or outward or both, from a first unit that includes the beginning of a storage space and certain other curatorial provisions. A small museum might have one consolidated unit of such space, but a larger museum would probably require a separate unit for each of its curatorial departments.

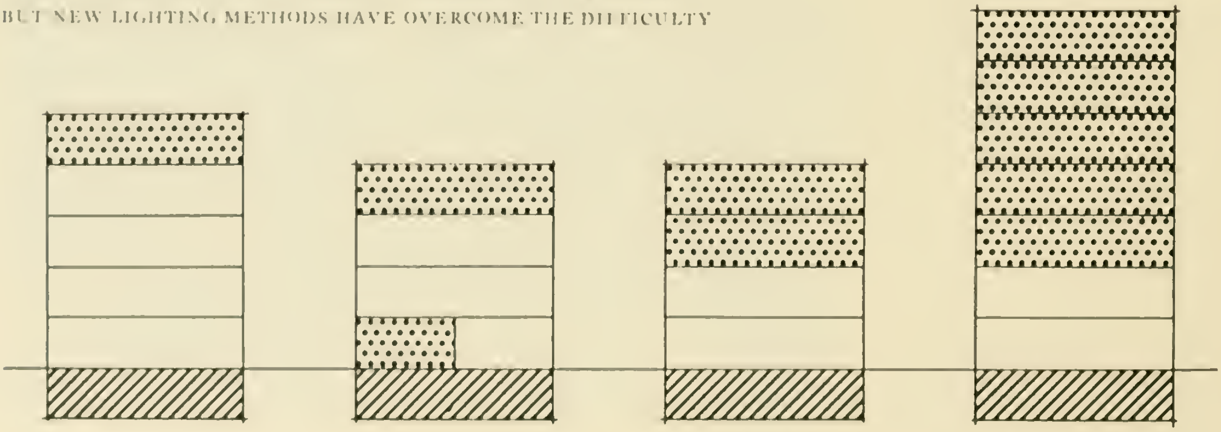
Construction of a live storage should be such that the particular collections it will contain are exactly provided for. This is a matter of layout, and of having the needed racks, trays, and shelves (page 244). Where the nature of the material allows for close construction, storages might be built like library bookstacks (page 163) with several levels of steel structure between each two concrete floors. A storage should be designed to give its contents deserved protection, and it should be capable of being put under lock and key. Artificial lighting of all parts of the space is important, though there may be natural lighting through panel windows that do not let in dust. Air conditioning is needed as much in storages as in other spaces.

Certain materials, especially materials of science, which are subject to attacks of pests or are quick to deteriorate, may require exceptional provisions. Thus a refrigeration room may be needed for cold storage of vertebrate material. Ordinarily this would have to be only for selected objects, so that a small cold room would suffice. There is a room of this kind at Rochester. A special museum with extensive needs of this kind may give the cold storage a larger place in its scheme of things, as at the Museum of Vertebrate Zoology, University of California, where there is a spacious refrigeration room, maintained at 40°F, for study skins.

Fumigation is sometimes carried out directly in storages. However, this demands almost impossible sureness in exhausting dangerous gases. The usual procedure is to take objects requiring treatment to a fumigating compartment (page 248).

Other special requirements are encountered with material preserved in alcohol. Collections in alcohol are heavy and are usually kept close to ground, where also it is cool and evaporation is minimized. However, without air conditioning, such a cool place might

GROWTH OF CURATORIAL SPACE (DOTTED) IN RELATION TO EXHIBITS (WHITE) AND SERVICES (HATCHED) SINCE 1877. MUSEUMS: (LEFT TO RIGHT) AMERICAN 1877, NATIONAL 1911, CHICAGO NATURAL HISTORY 1921, AND AMERICAN 1935. ART MUSEUMS HAVE NOT BEEN ABLE TO DEVELOP IN THIS WAY LARGELY BECAUSE OF SKYLIGHTS BLOCKING UPWARD EXTENSION BUT NEW LIGHTING METHODS HAVE OVERCOME THE DIFFICULTY



be useless because of condensation. The Hancock Foundation building, Los Angeles, has six levels of air-conditioned storage space for alcoholic materials.

Equipment of live storages is a question of special racks and cabinets (page 244).

Noncuratorial storage, by the way, is sometimes confused with storage of collections—at least in the architect's plans, where an otherwise useless space may be marked as storage space and the matter of storage so dismissed.

There are legitimate storage requirements of several kinds, apart from the curatorial storage needs. As we shall see presently, the receiving room should have nearby temporary storage place for boxes (page 197). There is need of storage space for exhibition cases and screens while they are off duty; for this purpose a part of the basement near the freight elevator is best as a rule. There may well be a small temporary storage near each exhibition unit—perhaps a small work and storage room among display rooms on each floor or in each wing. The registrar must have a safe place in which to keep things passing in and out (page 193). Also the director's office may require a vault for objects of exceptional value under consideration by the trustees. Such temporary storages of different kinds have nothing to do with live storages for collections.

Dead storage has no place in a live museum. Its presence is a temptation to bad institutional living. Yet more than one museum has spent considerable funds, perhaps given for enlargement of its building, in digging a subterranean pit for problem material that should be either absorbed into working material or disposed of without delay. It is true that some objects in almost any curator's possession may call for preservation in the dark and perhaps sealed from dust and dampness, but this is a matter of live storage in special containers or wrappings. Material worthy of such care is not the kind of stuff that gets into dead-end storage.

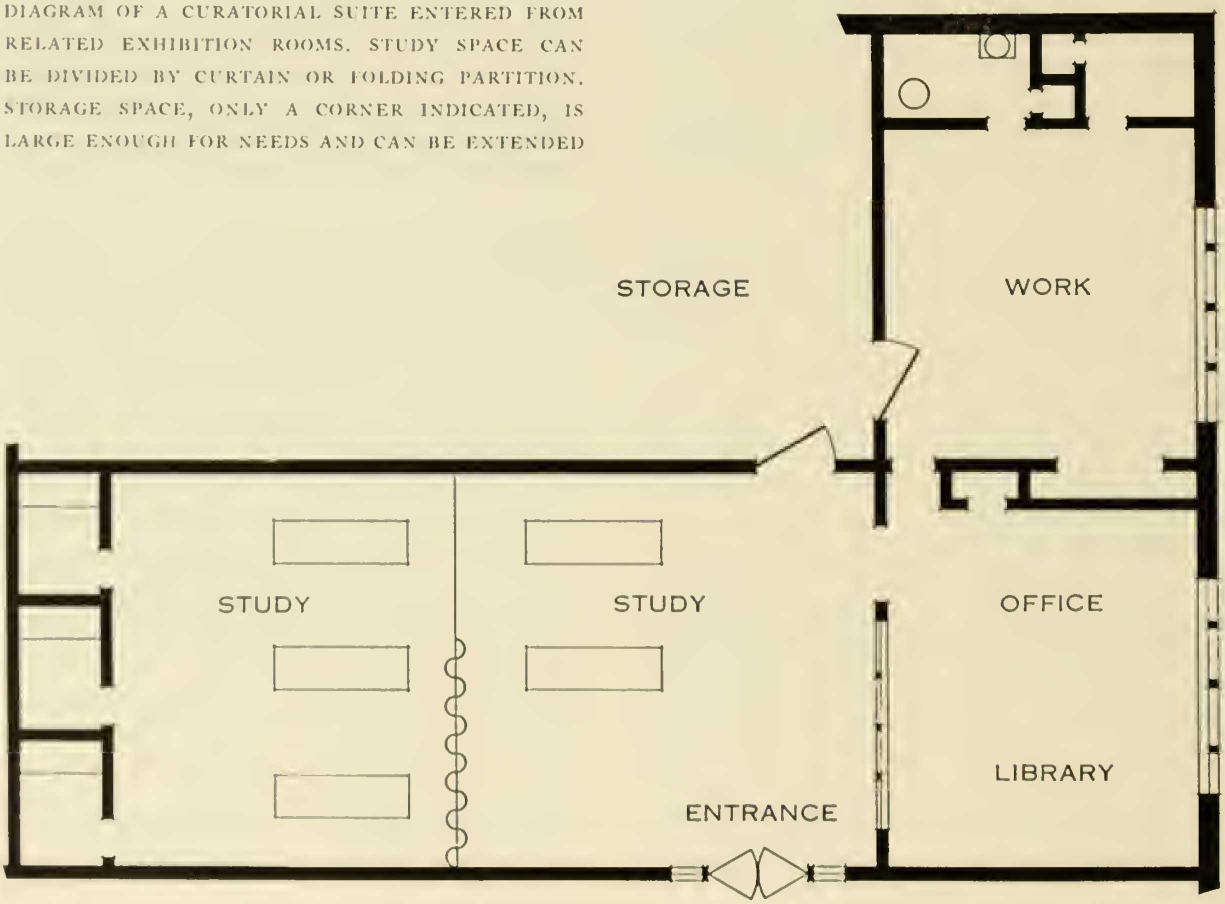
CURATORIAL SUITES, made up of study rooms, curatorial workrooms, and live storages, show the ultimate form of curatorial space in each department of any mature museum. Exhibition space is of course also a part of the curator's province, and the planner should seek to recognize this fact by relating each curatorial suite to the corresponding exhibits.

Some of the well developed departments of prints, of textiles, and of Oriental art in art museums show most plainly what kind of arrangements are needed; and even the science museums with extensive storage spaces may well notice these examples. The prints department at Boston, for instance, though in outgrown quarters, has a suggestively laid out assignment of space—made up of study, work, and storage space—adjoining the prints exhibition galleries. The Metropolitan Museum, though with its department of prints now somewhat scattered, has plans for print galleries leading to a spacious print study room that will have an office at one side, a workroom at the other, and expansible storage space beyond. The study room, says an informed correspondent, should be large enough for the maximum number of users and should have folding doors or screens to reduce the space for easier supervision of only a few people; "in other words, an arrangement like the balcony of a cafeteria to take care of the brief rushes." At Brooklyn, prints are housed in a remodeled area of the building. Here the visitor enters the prints department by way of a gallery, from which he can see through wide glass doors into the study room with its desk for the person in charge and its cabinets and tables for files and their reference use. Beyond the study room there is stack, or storage, space such as would provide for extension of the files of prints, although it is not now used for this purpose. The main reason for the lead of prints over some other classes of material, in the provisions made for them, is the comparatively small space requirements of prints, often capable of being satisfied without remodeling the building. A contributory reason stems from the greater opportunity for developing an important study collection of prints as compared with a collection of, say, paintings of equivalent usefulness to students and special workers.

Quarters of the larger textile collections give similar indications of what any curatorial suite should be like. At Boston, for example, there is a suite of three rooms—a study room, a workroom, and a storage—approached by way of the galleries of decorative arts. This unit too is a product of forced arrangements in space not planned for the present uses, and on that account it gives all the more conclusive evidence of what planners should seek to provide in the first place for each growing curatorial department, namely: exhibition space leading to a study room, with an office and workroom adjacent, and space to which future additions can be made for live storage.

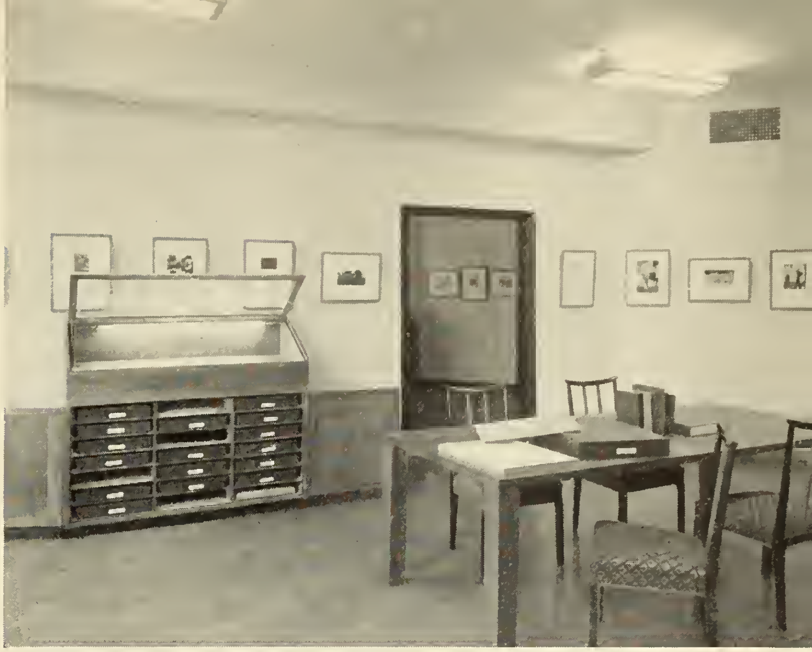
Oriental departments offer some further examples, perhaps because they tend to follow the Oriental tradition of keeping art objects in safety for only occasional viewing. Thus at

DIAGRAM OF A CURATORIAL SUITE ENTERED FROM RELATED EXHIBITION ROOMS. STUDY SPACE CAN BE DIVIDED BY CURTAIN OR FOLDING PARTITION. STORAGE SPACE, ONLY A CORNER INDICATED, IS LARGE ENOUGH FOR NEEDS AND CAN BE EXTENDED



the Freer Gallery, devoted to the Oriental field, each object has a place in live storage, the place being held when the object is on display; and there are the required nearby study rooms and curatorial workrooms.

Two other examples of good arrangements are to be seen in the departmental quarters of the Metropolitan Museum's Costume Institute and the Brooklyn Museum's Blum Design Laboratory, both of which are planned for active programs. The Costume Institute has a suite of special exhibition galleries leading to storages with adjoining office space, study cubicles, and a departmental library. The Design Laboratory connects with gal-

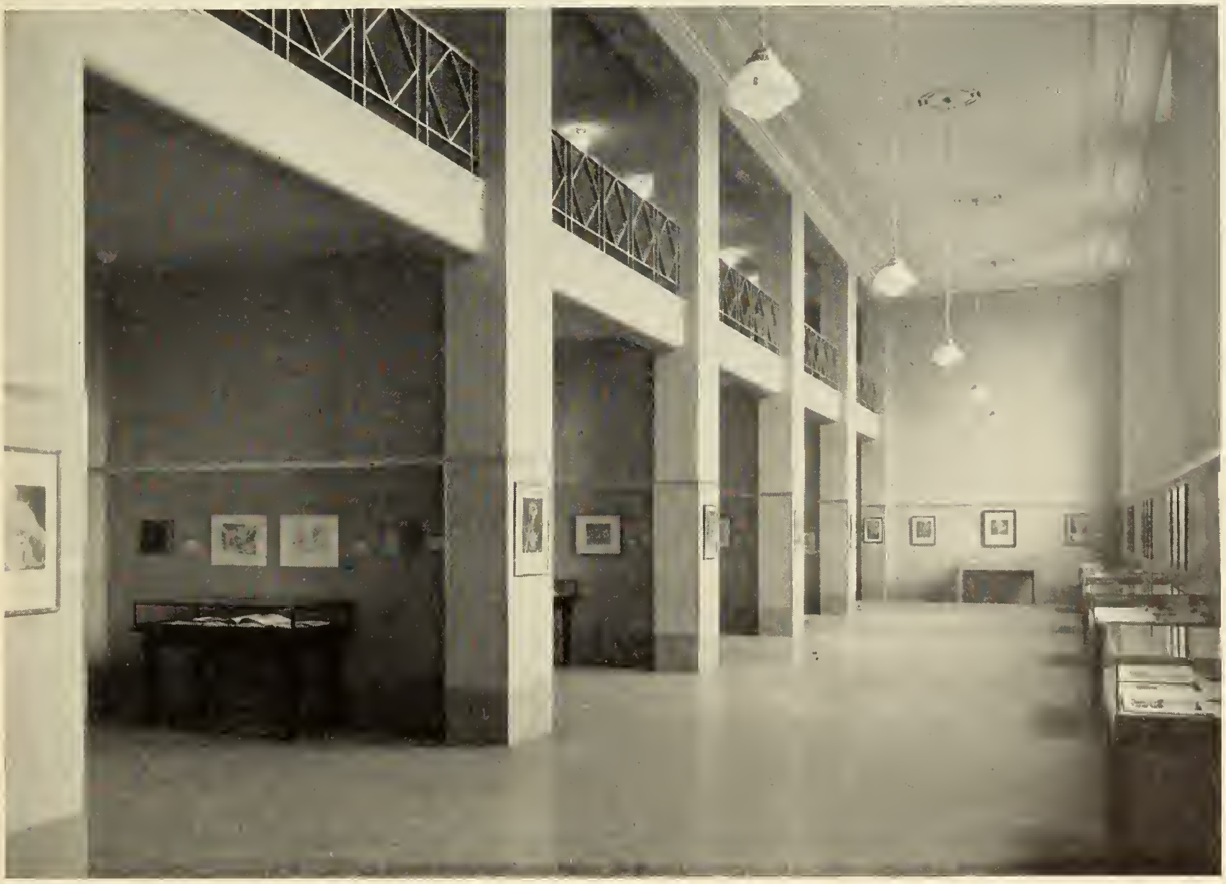


Courtesy Springfield Museum of Fine Arts, Mass.

EXHIBITION AND STUDY ROOM FOR A COLLECTION OF PRINTS, PART OF CURATORIAL SUITE OF A SMALL DIVISION OF PRINTS

EXHIBITION GALLERY OF PRINTS DEPARTMENT WITH AN OVERLOOKING MEZZANINE FOR STORAGE AND STUDY OF PRINT COLLECTION. A USEFUL FORM OF CURATORIAL SUITE

Courtesy Philadelphia Museum of Art



leries for changing shows on the theme of industrial art, and its suite has workrooms and cubicles for research workers around a curatorial office that communicates with a storage for textiles and costumes.

Many departments of paintings, unlike departments such as we have noted, are proverbially cramped in buildings that recognize few curatorial needs beyond those of exhibition. For some of the large and important collections of paintings, heroic makeshifts have been attempted; but for less commanding collections poor provisions have persisted— perhaps a room of racked pictures in the basement, if not an improvised storage behind the auditorium stage or in a skylight attic. On the other hand, a few museums have planned arrangements, for paintings, that are notable even though they fall short of what is recognized now as being desirable. In the Fogg Museum, the paintings department on the second floor has exhibition galleries at the front of the building and a study and well equipped storage with connected curatorial rooms at the rear. In the Springfield Museum of Fine Arts, Massachusetts, there are main-floor study and storage spaces, with curatorial workrooms connected.

It should be clear that the time has now passed in all fields for poorly planned storage spaces, unrelated in their locations to exhibits, unrelated to what study space there may be, and unrelated to the curator's workrooms. The number of extensive and meaningful collections in all the branches of art, as of science and history also, will be constantly increasing. Further, the studious public that can and will keep such collections busy is large and growing. Building committees and architects should recognize the change that has taken place in the curatorial sphere and should provide at least the rudiments of a suite, with live storage space that can be extended properly, for each small museum and for each curatorial department of a larger museum.

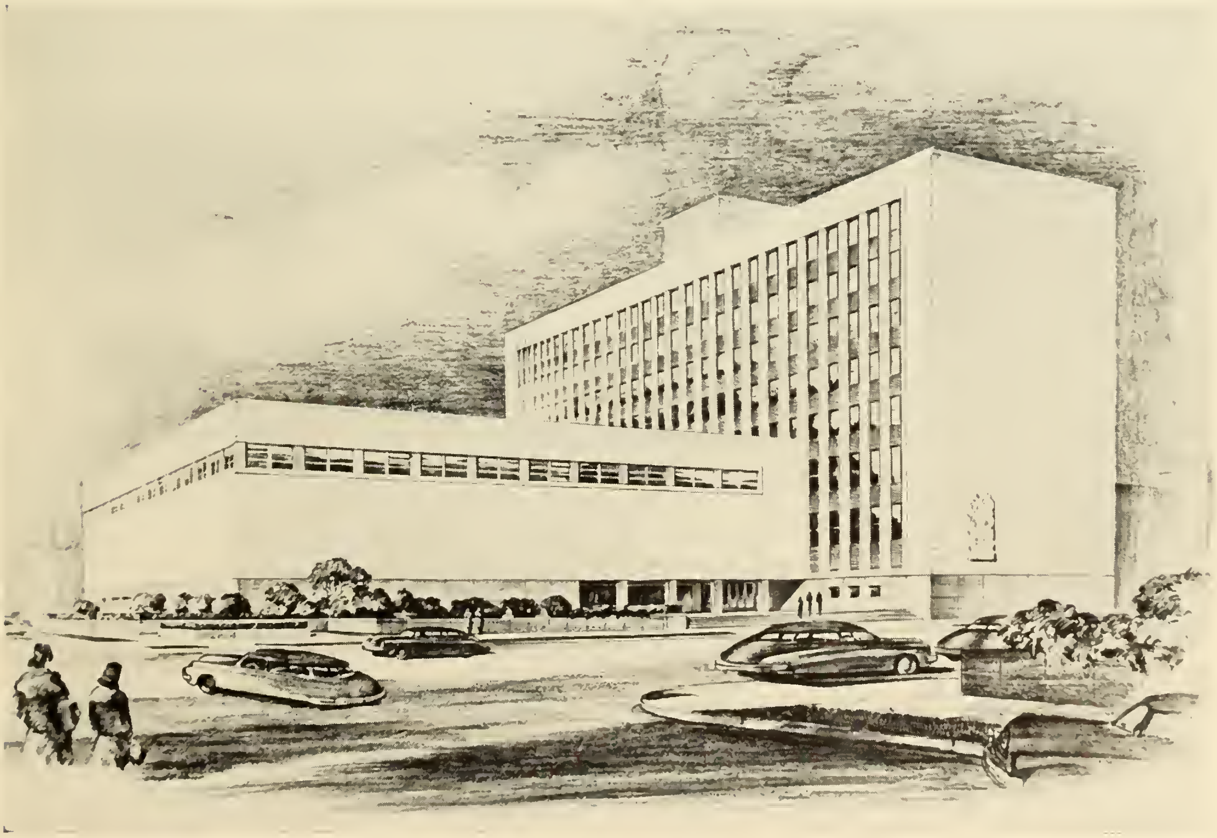
THE PLACE IN THE BUILDING that is best for curatorial space follows necessarily from the general organization scheme. Whether one would have to proceed onward or go upstairs or downstairs from exhibits in order to reach related study collections would depend in the first place upon the size of the building and whether it is developed vertically or horizontally. In a very small museum with a consolidated curatorial space, the relation of this space to exhibition space is likely to be determined entirely by the need for having the director-curator's office (the only office there may be in such a little institution) where it communicates with the lobby and exhibits. Thus the indicated plan might have live storage extending in one direction from the lobby and exhibits in one or two other directions, with offices adjoining the lobby at the meeting point of these spaces. Other dispositions of the curatorial area in small museums are suggested in the chapters on organization, exhibition space, and administrative space.

In a large museum, with several departments of curatorial staff and corresponding divisions of exhibits and study collections, curatorial space is subject to either of two influences suggesting different arrangements. Logic would put curators at the periphery as in the radial scheme (page 110), but practical considerations would put them near, perhaps above, the focal point defined by the public entrance. The latter plan seems better because it tends to keep curators in contact with each other and within the ambit of the director, rather than at far points where they can entrench themselves in comparative isolation. This suggests that study and curatorial rooms together with the entrances to departmental storages, like administrative offices, be placed where visitors can get to them easily from the lobby. However, such an arrangement need not conflict with the logic of having galleries serve as approaches to their related study rooms, since the public's route through exhibits in each department can be laid out so as to bring the visitor back to the lobby, from which point he can proceed to study rooms just as he might have done before his tour in the exhibits.

Whether the chosen position in the plan would be on the ground floor, below, or above, would depend on the type of the building. In general, the ground floor is fully preoccupied by its commitment to exhibits. Equally pressing, in general, is the commitment of the basement to services, as we shall see presently. This leaves the floors above the exhibits as the inevitable whereabouts of any large curatorial spaces. We have already noted the stalemate that skylights produce, and we have noted also that advances in lighting practice have released museums from this troublesome deadlock. Now modern style gives the planner freedom to compose a building in masses rising to different heights over different parts of the ground plan.

It is apparent from current projects that a familiar building form of the future will have a block of curatorial space rising vertically through several stories (perhaps with inter-

INDIANA STATE MUSEUM PROJECT WITH CURATORIAL BLOCK RISING BESIDE EXHIBITS
WALTER SCHOLER AND ASSOCIATES, AND BEINE, HALL AND CURRAN, ARCHITECTS



story levels, as in bookstacks) and one or more blocks of exhibition space developed horizontally. This form would provide curatorial spaces with ways of being enlarged to meet future requirements, since additions to a vertical block, whether to carry it upward through added levels or outward through added blocks, can be envisaged at the outset. A very distinguished project for the National Institute of Archaeology and History at Mexico City, offered by Architect Luis Mac Gregor K., would give this plan an embodiment that should be influential.

Two other methods of relating curatorial and exhibition spaces are seen in recent practice. One divides a compact wing longitudinally. The other puts exhibits on the inside of a unit and surrounds them with workrooms and storages. The best example of both plans are abroad: of longitudinal division in the Statens Historika Museum at Stockholm, and of surrounded exhibits in the National Museum of Wales at Cardiff. Both schemes appear to some extent in American planning —the former, for example, in the project for a new Illinois State Museum building, and the latter in the Nebraska State Museum.

These observations suggest still another arrangement that seems deserving of study. If planners adopt the idea of using for orientation the central space in any unit of a building, then a study room might occupy the part of this space nearest to the lobby, curatorial offices might be above, and storages might be at still higher levels. This ties in remarkably well with the practical suggestion, made by curators, that the study room of any department be on a mezzanine or balcony above an exhibition room and that other curatorial space, reached from the mezzanine, be placed for outward and upward extension of storage capacity.

Whatever the solution in any particular case, building committees in the future should consider it an inescapable duty to provide for growing collections in live storage.

CHAPTER XVI. ADMINISTRATIVE SPACE

The offices of the director and business staff form a category of space that sets problems quite distinct from the problems of curatorial offices and other special work rooms. The number, size, and nature of the needed administrative offices will naturally depend upon the particular institution; but every museum, whether large or small, should have adequate and well placed space for its administrative personnel. The building that fails so to provide is obsolete in that respect before it is put into use.

LOCATION OF OFFICES in the building is a matter of very practical concern since business visitors should not have to be privately conducted, nor should they be sent exploring through the building (least of all before and after the public is admitted) in order to reach a member of the staff. The main entrance, not the service entrance (see next chapter) and surely not a special business entrance, should be the approach to administrative space. The visitor coming on business almost always presents himself at the principal portal; and sending him from there to the back door or any other entrance, whether by way of the exhibits or the sidewalk, is exceedingly awkward.

The route from the main entrance to the offices should be under control in the lobby. This is partly for convenience and efficiency, and partly to prevent thefts from offices. The path to offices from the entrance should be short and direct. This suggests that the front of the building, on one or more floors, should be devoted to offices in any large building. The Rochester Museum of Arts and Sciences has its public relations offices on the main floor, front, and its business offices on the second floor, front. From the administrative offices it should be easy to reach the educational division, curatorial offices, and service quarters. In some buildings work spaces on different floors are interconnected behind the public scene.

Where there are several floors reached by an elevator at the front of the building, offices may perhaps be placed high. This arrangement is seen at the Museum of Modern Art. However, it should be remembered that administration has good reasons for not being far from the basement, since it has much to do with the functions of receiving, shipping, registration, shop work, and superintendence, which are rooted to the ground. On a site where land falls away at a side of the building, giving light and air to the basement, offices may find their best place at this level.

In a small museum the space for the staff—often a consolidated space for the person who is all functionaries in one—has to be where it can give the best possible command of different parts of the building. The once familiar plan in which the director had only a cubbyhole off the vestibule does not of course meet this need satisfactorily. The relation of the office space to other spaces should reflect actual tasks, in a museum small or large.

ROOMS REQUIRED for administrative work begin, logically, with a board room for meetings of trustees; but practical considerations in all save the larger museums suggest that the board room be made a part of the director's office. Where the board room is separate it should communicate with the director's office, and should

Courtesy Museum of Modern Art, New York

GENERAL OFFICE WITH UP-TO-DATE EQUIPMENT COMMUNICATING WITH NEARBY EXECUTIVE OFFICES ON THE SAME FLOOR

A WELL APPOINTED OFFICE FOR THE DIRECTOR

Courtesy Cranbrook Academy of Art, Bloomfield Hills, Mich.

be planned with a view to its general use as a room for meetings including luncheon meetings. The work of the board may require wall space and shelf or counter space for display of a few objects at a time, and it usually calls for a nearby small vault, perhaps in the adjoining office.

The director's office, like other principal offices, ordinarily needs a separate outer office for secretarial work and reception. A small toilet room connected with the office and the board room is advantageous.

Other offices are required in museums of much size for the assistant director, finance officer, membership secretary, editor, and public relations head, each with his helpers. An institution's staff structure gives a prescription for office space. There may be a general office for a part or for all of the secretarial force. The registrar's office has to be placed elsewhere. Educational, library, and curatorial offices also are discussed in other chapters. Providing offices for outside organizations or political functionaries is advised against very strongly.

Modern, ample, efficient workplaces are essential. Offices should have proper closet and cabinet space. There should be convenient toilet facilities for the staff, and in addition wash bowls in the offices themselves are desirable. Dividing partitions should be light, and they should extend to the ceiling in executive offices at least. Flooring is commonly of linoleum. The ceiling should be treated acoustically. Air conditioning should include the offices and all other work spaces—it being false economy to neglect the comfort of the staff. There should be windows to let in some natural light, and the windows should be fitted with Venetian blinds. There must be artificial lighting—both general lighting and stronger local work-lighting.

CHAPTER XVII. SERVICE QUARTERS

Housekeeping services of the museum are a varied lot of activities having to do with supply, maintenance, and shop work, and with the arrival, movement, and departure of museum objects and exhibitions. The artisans and laborers of the service force engaged in these operations are under control of the superintendent, who is responsible for the passing of people and of things through the service entrance, and for the conduct of services in the building. The superintendent's office should be at the service entrance to facilitate supervision. The service entrance, which leads to workrooms and other parts of the service quarters, should be placed to facilitate truck deliveries and pick-ups. As a rule this entrance is at the back or side of the building, and at best it is in the basement if the land makes this possible without forcing the main public entrance to be raised far, if raised at all, above street grade. A very good kind of site, therefore, is one with land falling away toward the back or one side, although an equivalent arrangement on level ground is often made by excavating a service area and a descending truck driveway. Some museums on small in-town plots have the service driveway passing inconspicuously through the main façade of the building.

The rooms of the registrar and photographer should be grouped with service quarters since recording and photographing of museum objects that come and go can best be carried out near the service entrance.

The following discussion owes much to a published study of this category of space: *Planning for Art Museum Services* by Clarence S. Stein (*The Museum News*, Jan. 1, 1939).

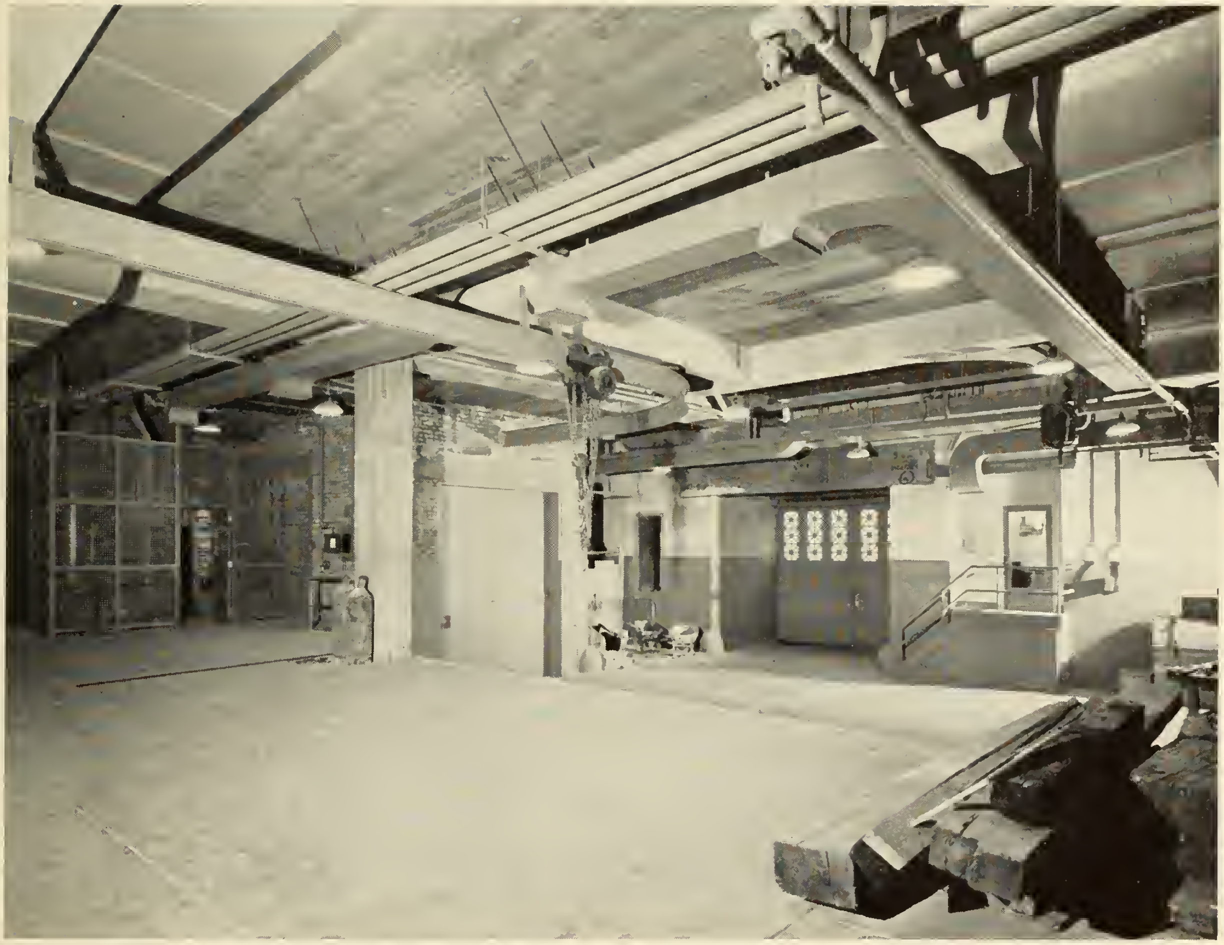
THE SERVICE ENTRANCE leads directly to the receiving room with a packing and unpacking area. This is the distributing point for the entire building. In large museums it should be placed so as to minimize hauling distances from the freight elevator on floors above. The service entrance should have a doorway for the use of service employees, delivery men, and other persons entering on foot; and it requires also a freight portal for the use of trucks. Where there is sufficient room, provision may well be made to have trucks drive within the building for unloading or loading behind a closed and locked door; but if the platform is in the open it should be sheltered from rain. Outside space should allow for any necessary turning of large trucks; and there may be a parking space here for cars of staff members—a space so arranged, by the way, that delivery trucks will not back into staff cars by mistake. The drive and delivery area should be graded and paved for heavy trucking, and may be screened by a parapet or plantings.

The loading platform should be designed to take account of the sorts of material and the sizes of trucks that are destined to make calls upon it. It should give handling space at the tail and conveniently also at one side of the truck. It may be from 36 to 46 inches high (40 inches being a fair compromise) since the tail gates of most city delivery trucks are 36 inches or more high and of commercial trailer trucks often 46 inches or more high. The platform should be horizontal, and it should have a narrow flight of steps leading to it from the ground for the use of people on foot. At best, the truck space would have clearance for a truck 10 feet wide and 15 feet high, and would be deep enough so that a truck 25 feet long—or 40 feet long for trailer trucks—could stand in it without blocking the service drive. However, for a small museum it may suffice to have only outdoor space for a truck backed to a sheltered tail platform. If conditions so require, the space may be at an angle of not more than 30 degrees to the drive and partly in a recess of the building; but a space for straight backing is better. The plan of having trucks drive right onto the main exhibition floor of the museum for unloading, as at Grand Rapids, is ingenious but has many disadvantages. The best arrangement gives a receiving room and entire service floor on a level with the loading platform. Unloading downward to the level on which a truck stands, even with the help of a chain fall or of an elevator used as a platform, is strongly condemned. If there is a chain and block, either fixed or running on a rail, for use in removing large objects horizontally from truck to receiving room and freight elevator, it should give at least 10 feet of vertical clearance below the tackle.

If the truck slip is not within the building, behind a door that can be locked while unloading, then the receiving room should be separated from the loading platform by a sliding or rolling door that can be securely locked. This doorway, in order not to become a bottleneck at times, must be wide and high—at least ten feet in each dimension.

THE RECEIVING ROOM is a focal place to which incoming shipments come for unpacking and distribution within the building, and outgoing shipments go to be packed and sent away. Other rooms having to do directly with these functions, that should connect with the shipping room, are the superintendent's office, the temporary storage room for crates that are saved for return of their contents, and the registrar's and photographer's quarters in which museum objects coming and going are recorded and perhaps kept for a time. The freight elevator should be here. Not far away should be the shops, which can thus readily get their materials and give up their products to be moved into place in the building. In a large museum the shops and registrar's quarters may both be made up of several spacious workrooms and connected storage rooms, but only in a small museum that has very little to do with trucks and crates can any of these related kinds of work be carried on in the receiving area proper.

The receiving room and the freight elevator should lend themselves to movement of materials throughout the building. There may well be a straight line of flow through the service entrance and the receiving room to either the elevator or a service corridor. Having a route that passes *through* the elevator from front to back is decidedly not advantageous, since access to the corridor is thus blocked when the elevator is at any other level. The storage place for lumber should lie as nearly straight away from the receiving entrance as possible to facilitate the movement of boards up to 20 feet long. Lumber should not have to be taken around a close corner, stuck up the elevator shaft, or sawed into short pieces in order to get it into the building. The crate storage is sometimes placed at sub-basement level, reached by the elevator; but one level for all services gives a better arrangement. The shop or shops are well placed off one flank of the receiving room, and connecting easily with storages for materials. The registrar's quarters may be off the other flank of the receiving room. The photographer's workrooms find their natural place adjacent to the registrar's room. This space may be centrally placed in the plan since natural light is excluded anyway (see another section, below) but it should not be far from the freight



Courtesy Museum of Science and Industry, Chicago

RECEIVING ROOM OF A LARGE MUSEUM. ENTRANCE, 14 BY 12 FEET, ADMITS TRUCK AND PLATFORM MEETS TRUCK LEVEL. ELEVATOR CAPACITY 20 TONS, HOIST 5 TONS

elevator or otherwise cut off from ready access to all parts of the building.

The floor area required for work of the receiving room proper has to be judged by the nature and program of the museum as well as by the size of the building, since large objects take up much space in handling and temporary exhibitions mean many boxes to move. Several small museums get along all right with about 500 square feet, but most of the active museums have upwards of 1,000 square feet, and some large museums have more than 2,500 square feet.

The receiving room and all the work spaces around it—except the photographer's quarters—require general natural lighting by windows and also artificial lighting sufficient to give work light wherever it is needed.

The receiving room floor may be of heavy asphalt sheets laid in mastic over the concrete, or it may be of creosoted wood blocks laid on end grain.

Means of protection against hazards of fire and theft are imperative. Fireproof construction, proper care and disposal of waste, and isolation of the incinerator and paint storages are elemental points. Doors of the service entrance should have stout locks and alarm protection. Doorways from the receiving room to the registrar's quarters, the shops, the service corridor, and the crate storeroom should have either fire doors with locks or fire curtains with fusible links in addition to lockable doors. There may well be sprinklers in the crate storage, but not in any of the rooms where water could damage museum objects.

Some museums have the shops and their paint and lumber storages, and the incinerator, near the power plant in a separate structure well removed from the main museum building. At Cleveland this is so; and the 300-foot passage from plant to museum has a fire door at one end and an automatic fire curtain at the other. However, the receiving room and closely related units have to be in the museum building to facilitate the movement of museum objects and supplies.

THE SUPERINTENDENT'S OFFICE, adjacent to the service entrance, is the control room for all that happens here. A large museum may have a guard's desk at the actual point of control, and the office nearby; but in most museums the superintendent is placed physically where he can see for himself, through a window or glazed partition, what goes on at the entrance and in the receiving room. There may be an inner and outer office in a large museum, and space should be allowed here for spreading blueprints as well as for office work.

The path of entry afoot (from the loading platform which in turn should be reached by a narrow flight of steps) may well be through the superintendent's outer office. In a small museum, the equivalent of all these arrangements can be made quite simply in a single receiving space. For service employees there should be a time clock and a bulletin board outside the superintendent's office.

THE FREIGHT ELEVATOR, at best directly beside the receiving room, should be large, slow, and powerful, and should be operated by push button. It must squarely reach all levels to which its loads might have to be taken, not dependent on a ramp to finish its work at the bottom or top of the shaft. If, in a building of more than one story, funds do not at first allow for this elevator, the shaft should be provided for a later installation of equipment.

Experience favors a very large elevator cab—at least 6 by 12 feet, with openings of the full width and height. Larger dimensions are common: 7 by 13 feet at Portland, 8 by 15 feet at Boston, 9 by 16 feet at Washington's National Gallery, 11 by 20 feet at Philadelphia's Franklin Institute—the last allowing for trucks to be taken to any floor level. A removable cab roof may be helpful with long objects. Ordinarily—that is to say for a museum that does not plan to take in large pieces of machinery or other excessively heavy exhibits—an elevator of three-ton capacity should be adequate; even a small museum is likely to need this capacity at times. Several large museums report elevator capacities of six tons or more.

The elevator shaft, at best, should not open directly into exhibition rooms. An intermediate lobby is useful in many ways and helps appearances by keeping work operations out of sight. However, direct access is better than a bottleneck; for sightliness the elevator doors may then be screened by draperies hanging in straight lines.

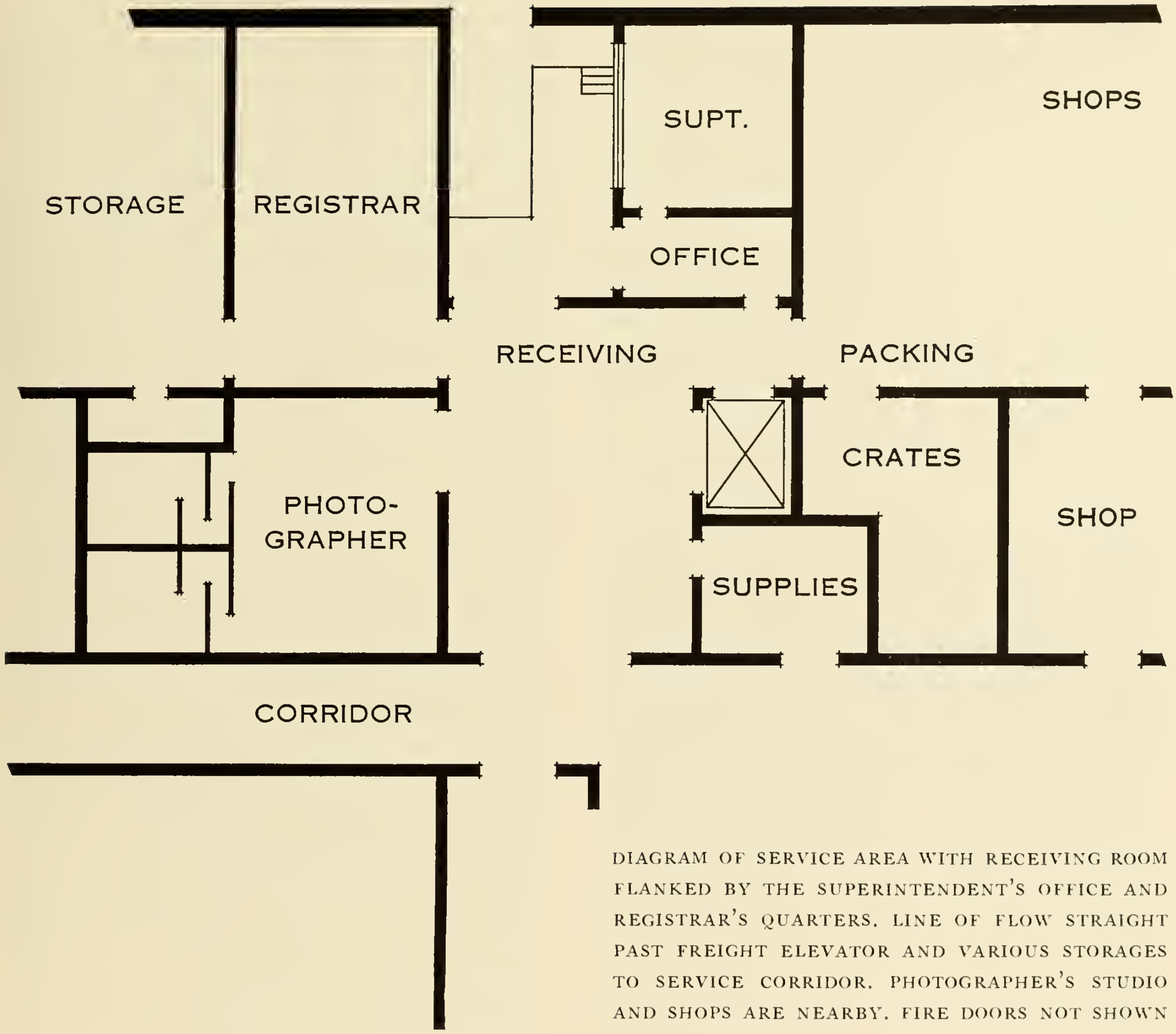


DIAGRAM OF SERVICE AREA WITH RECEIVING ROOM FLANKED BY THE SUPERINTENDENT'S OFFICE AND REGISTRAR'S QUARTERS. LINE OF FLOW STRAIGHT PAST FREIGHT ELEVATOR AND VARIOUS STORAGES TO SERVICE CORRIDOR. PHOTOGRAPHER'S STUDIO AND SHOPS ARE NEARBY. FIRE DOORS NOT SHOWN

THE REGISTRAR'S QUARTERS, where records of museum accessions and of borrowings and lendings are kept, form a place of pause for museum materials on their way to or from the exhibition rooms or curatorial quarters. The registrar's room should communicate freely with the receiving room, and should also be arranged for complete closing under very stout lock. In a large art museum, the two parts of the registrar's work, namely, work with acquisitions and with temporary shows, may be served best by having a room for each. But, however this may be, there must be space for examining objects and assembling fairly large groups of things coming or going, a place for the registrar's office work, and a safe temporary storage place perhaps with a vault as well. The storage place may require simple picture racks, and it should have shelves to take the kinds of things customarily handled in the museum.

The registrar's quarters should not be placed on another floor from the receiving room, or divided between two or three floors. It is not enough that the freight elevator connect such scattered spaces with the receiving room; the registrar needs to be right on hand when many a crate is unpacked.

The registrar's temporary storeroom should not be confused with the temporary storage in which empty crates are kept while awaiting reuse. The latter place needs sprinkler fire protection, but no part of the registrar's quarters should be thus subjected to the water hazard. Further, the registrar's storeroom is not to be confused with the curatorial storages that are found in the basement of many a museum. The registrar's room is strictly a place for momentary safekeeping of museum pieces passing in or out.

The registrar usually has one small outlying province—the fumigation chamber. On account of the fumes it gives off, this is at best put near the roof, although its discharge can be piped to the roof if the chamber is in the basement. This piece of apparatus (page 248) should not be very far from the freight elevator, since hand trucks may have to be brought to it from any part of the building.

SERVICE CORRIDORS are arteries of travel for people and things in the basement. Freedom in this passage and unobstructed passageway on other floors through public halls and rooms should provide a distributing system to all parts of the building. If perforce the receiving room is in some unfavorable position, a service corridor at the same level should connect it with a better placed freight elevator, in order to secure delivery at convenient points on other floors, but ordinarily the greatest movement of exhibits, between the elevator and places of display, is through public rooms; and the movement of supplies and the like to storerooms or workrooms is by way of a service corridor in the basement.

There should be no bottleneck in any part of this system. Small doorways and sharp turns may negate passages that are ample in other respects. Vertical clearance of at least 10 feet and effective width equal to that of the freight elevator are essential at all points. Since the basement corridor must sometimes provide passage for long or otherwise awkward materials, a diagonal route may be better than a route with a right-angle turn or with two turns dividing the angle. However, best of all is the service routing that leads straight away from the receiving room, past the registrar's room, past the service elevator, to the rooms it must lead to most often, namely, the carpenter, paint, and mechanical shops and their storerooms on the one hand, and the photographer's studio and restorer's and preparator's rooms on the other.

For protection against spread of fire, there should be wide and high fire doors or fire curtains, with fusible links at carefully chosen points.

PHOTOGRAPHY WORKROOMS, once commonly placed in the attic for access to north light, are now placed by preference in the basement where natural light can be excluded and the photographer's work carried on by more easily controlled artificial light. The basement location has also the crucial advantage of being near to the registrar's quarters where objects await the camera. The photography rooms should have air conditioning, and careful guarding against vibrations set up by the mechanical plant.

The floor area devoted to photography is in many cases either too large or too small. There are more-than-generous spaces in which the photographer loses time and suffers inconvenience by having to walk around excessively; and there are crowded spaces in which the work is hardly possible of performance. Even in a small museum, where photography is often a part-time task, there should be an arrangement of apparatus that can be used directly for any usual process without moving the trappings of some other process. And in a large museum with a constant flow of photographic work, it is well to divide space in such a way that any number of the customary operations can be carried on at once. This means a studio, or camera room, of at least 250 square feet (say 15 by 17 feet), and two darkrooms that can be entered independently from the studio—one room of about 40 square feet (say 6 by 7) for loading and unloading and film developing and drying, and another of slightly larger size (say 8 by 7) for printing, enlarging, and the developing, fixing, washing, and drying of prints. The studio should be longer than indicated here if large objects are to be taken. Each darkroom requires its appropriate sink and counter space, besides places for the usual pieces of apparatus, and shelving for supplies. The main stock of supplies and negatives is best kept in the studio in a closet or cabinets. Mixing of chemicals can be carried on in a separate place with a sink.

The doorways from studio to darkrooms are now usually fitted with light traps, or baffle arrangements of partitions, so that one can pass through without having to negotiate double doors. The partitions of the light trap should be planned for completely stopping light; quick passage of the worker, however important, is secondary to this.

Some of the best photographic laboratory suites in museums have been produced by remodeling basement space in old buildings. The latest of these is at the Art Institute of Chicago and is described by Lester B. Bridaham in *The Museum News* of Oct. 1, 1949.

The file of photographic negatives that have been exposed is sometimes kept in the educational division, but a better place is near the photographer's studio. There should be ample provision for this, with drawers and cubbyholes as required. The file of reference prints is rightly kept in the library or the educational division. Storage of motion picture film, including all nitrate film, is a separate matter, calling for a safety vault.

Laboratories for examination of paintings and other objects by chemical and special photographic means are found in a few art museums. This work is not sufficiently common to warrant a general recommendation as to its whereabouts in the building, but its affinities are with the work of curators rather than of photographers. The Fogg Museum of Art at Cambridge has extensive laboratory provisions of this kind.

SHOPS are required in every museum, whether as a room in a little institution or as a ramified department of work spaces in a large institution. One recent building that fails to acknowledge this fact now has its carpenter at work in the fanroom—from whence his dust and noise and his occasional pointed remarks are distributed by the air ducts to all parts of the structure. Not only should adequate space be provided in a suitable location, but too the space should be planned for the required shop operations by someone with experience in such work. A museum that makes its own cases has greater needs than one that does not. A science museum, fabricating many of its own exhibits, makes calls on its shop that are different from the calls of an art museum. In a little museum the superintendent may be the artisan as well, but some of the big museums have upwards of 25 carpenters, painters, and mechanics.

The principal kinds of shop work for which provisions are needed, in keeping with the size and program of the establishment, are: carpentry, including both mill and cabinet work; painting and finishing; machine and sheet metal work; and, in a complete museum, the various shop processes that go with plumbing upkeep, steam fitting, electrical maintenance, plastering, roofing, glazing, and the care of other plant and structural installations in the building. There are also some very important museum crafts that are independent of the work of the shops although they may call on the shops for some of the construction they require. These are the crafts of the preparators, workers who are charged with the creation of exhibits and the care of museum collections. We shall come again to this subject below.

The size of the shop area can hardly be less than 500 square feet under any conditions. Where the shops are active there is need for at least 1,000 square feet, and museums of no great size commonly have two or three times that space while some big buildings show from 5,000 to upwards of 10,000 square feet.

The best place for this area, as already pointed out, is likely to be on one flank of the receiving room. With this arrangement, lumber and other materials can most easily be taken in and stored where the shop force will have them at hand; and in this position, also, the shops can readily pass on finished cabinet work and other products to the freight elevator, by way of the receiving room and perhaps the service corridor. It is a serious mistake to put the shops in a sub basement, as has been done in more than one museum. It is equally a mistake, though for partly different reasons, to put the shops on one of the upper floors. The only fair alternative to the suggested plan seems to be that of having the shops in a separate building, the advantages of which are reduction of the fire hazard, and avoidance of dust and noise. The greatest disadvantage is remoteness from the receiving room, which itself must not be so placed.

Necessary measures to reduce the risk of fire in the shops are: putting the paint storeroom at a little distance and perhaps underground, isolating the shops with extra fireproof construction and fire doors, and having sprinklers at least in the lumber and paint storages. Some museums have sprinklers in the carpentry and paint shops also. The shops should be dependably dry, as well as inaccessible to rats and other vermin—including thieves.

Like all workrooms, the shops should have good natural light, and also artificial light sufficient for all the usual operations and for general lighting of the space as required.

The shops, including their storerooms, should be air conditioned. Ventilation, at least, is imperative in the lumber storage to keep the stock in shape. Machines that produce much dust should have dust-collecting attachments.

The flooring in shops should be of wood, except that painted cement is preferable in the machine shop, where service demands are heavier and oil and grease are ever present.

The equipment of shops had better develop from needs as they are felt than to be laid out far in advance. However, to begin with there should be, for wood working: a long bench for each carpenter, a table circular saw, a band saw, and perhaps a joiner and a planer; and for metal working: a bench, a 10-inch machine lathe, a small drill press, a power grinder, and perhaps a bar folder and a squaring shear.

PREPARATION AND RESTORATION ROOMS, which are the special shops and studios for preparators of science exhibits and for restorers of art exhibits, are not functionally kindred to the mechanical workshops. Preparators and restorers collaborate with curators. Museums often attach these technicians, artists, and craftsmen to the departments they serve, and tend to locate their workrooms in curatorial suites. For the very specialized work of restoring paintings, and for light and skilled work such as mending textiles and repairing many other works of art, or mounting insects and other invertebrates or making birdskins, this is the best arrangement. But there are heavy and often noisy and litter-making crafts—for instance, upholstery, plaster molding, mammal taxidermy, accessory work for habitat groups, and mounting of vertebrate fossils—that had better be in the basement with other heavy operations. In a small museum there may be only one general preparator, and only one possible workplace of any kind. A room in the basement, near the freight elevator, may do.

There are some shops that have to be isolated in any case—notably the tannery and the macerating room in a science museum. The character of the work in these rooms may even suggest a shed at some little distance. In fact there is one process that demands complete banishment—that of cleaning small skeletons with the help of dermestes beetles that would be only too delighted if they had access to all the museum's collections.

Studio arrangements should be suited to the particular work. There must be good natural side light—especially good for restoration of paintings—and such artificial lighting as the operations call for. All shops and studios should have large sinks with running water and drain traps for plaster and debris. Flooring should be of wood or linoleum, except that wet work like plaster molding requires terrazzo or tile. Storage closets and shelving are ever useful. Walls should be plain, and preferably of composition board or some other material that will take nails, and that can be renewed by repainting.

A scheme, often suggested but never tried, that would draw much attention and perhaps improve the work of the shops, is that of having an overlooking balcony or observation windows for the visiting public.

THE PRINTING SHOP may be a place for a small hand press, used to make labels and do other simple jobs, or it may be a printing establishment equal to turning out books and serial publications. If it takes on much size and has floor-load problems, it should be in the basement. Otherwise it can be almost anywhere.

SERVICE STORAGE SPACE, for exhibition cases and other equipment when not in use, is a convenience that can easily be turned into a drawback. The lurking difficulty is that such a space will be used as a storage place for collections—against which the best defense may be to leave it as open space with a concrete floor and sprinkler protection.

Other housekeeping storages, as of restaurant supplies, janitor's supplies, office supplies, and any other materials not provided for by the several special storage places suggested, should be put in places convenient to those who use them. A small storage space in each exhibition area or suite of exhibition rooms has already been noted as of use when exhibits are being installed.

QUARTERS FOR THE FORCE of artisans and laborers are a necessary part of the service layout. These should be easy to reach from the service entrance where the help checks in and out, and they should be arranged in keeping with the number of people employed. In a small museum the superintendent himself may be the whole service force, whereas in a large museum there may be several numerous groups of service personnel under chiefs of engineering, construction, guarding, and labor.

For each group that must be given separate rest accommodations—ordinarily only two, namely, men and women of the force—there should be dressing and locker space and a connected toilet room and lavatory with one or more showers. Also there is much to be gained by providing, near the locker rooms, a room for smoking and eating box lunches.

LIVING QUARTERS may have to be provided for an employee in residence at the museum. This is not usual among public museums, as it is among historic house museums, but nevertheless there are public museums at which anyone from the director to the watchman lives on the spot. The plan works out best for a janitor, gardener, or watchman, according to circumstances. In several museums the superintendent has an apartment provided.

No matter where the gardener lives, his mower, hose, and tools require a convenient storage place with a door to the lawn.

THE GARAGE is an optional facility that most museums could use but that many get along without by having a parking space for the museum's delivery truck and other cars. The plans for a new Illinois State Museum provide for a subsurface garage outside the building and reached by a ramp from the flanking service area—which, by the way, is itself covered by a roof slab across part of the moat that half-surrounds the building. At Grand Rapids there is a garage in the building itself. And at Flagstaff, already noted as having a cluster of buildings, there is a small outlying garage.

CHAPTER XVIII. HEATING, VENTILATION, AIR CONDITIONING

Air Conditioning is indoor weather control. Heating is the most urgent and also the oldest part of this process. Museums have been heated in cold weather from the start. Ventilation was undertaken later, and its methods were improved with the improvement of heating methods. Overcoming the dryness of heated air in cold weather came next, beginning for museums in 1909 at Boston. Summer cooling of museums, and the attendant removal of excess humidity, was a development of the 1930's. Complete air conditioning—with winter heating, summer cooling, and year-round control of humidity as well as cleaning of the air before it is moved through the building—is what people have come to expect in urban public buildings. Museums are now planned accordingly.

STEAM HEATING, by one method or another, is almost universal in museums. Hot water heating is not entirely suitable, if only because of its excessive space requirements for radiation. Electric heating may find supplementary uses in museums, but otherwise is not much employed. Hot air furnace heating, that sends up dusty draughts from the cellar, is suffered in some small museums. But most museums, small and large, employ steam to carry the heat from its source to points of application.

However, steam heating *by means of radiators,* though long established in museums as in residence and business buildings, is now going out of use for museum purposes. With the development of forced ventilation and filtering, radiators began to be retired from exhibition rooms, where they had always been in the way; they were relegated to fan rooms and given the form of heating coils in systems of blowers and ducts. This change was accelerated by the later growth of air cooling and humidity control.

Steam production, for heating by means of radiators or the newer heating coils, and perhaps for other purposes as well, is a perennial museum concern. Where there is a district heating system, to provide steam from the central plant of a public utility company, large institution, or group of government buildings, it is advantageous to purchase steam—for reasons of lower initial cost, reduced space requirements, and avoidance of nuisance—although the operating cost of this plan may be higher than that of an individual steam plant. Many museums, notably the national institutions at Washington, state and university museums generally, and public museums in a number of cities (Cleveland and Detroit, for instance) get district steam.

Museum steam heating systems—including boilers, steam main and piping, radiators or coils, and accessories—have been designed for many different conditions. Low pressure systems with vacuum returns are generally in use, and are especially applicable in large installations.

The boiler room of a museum making its own steam is usually in the sub-basement, or at a level some feet below the rest of the basement floor. In a large building this space is centrally placed as a rule; but in a small building it may well occupy a corner, where it can be isolated and ventilated more easily. A still better location, if the museum has sufficient land, is in a separate structure at a little distance from the main building. The Nelson Gallery at Kansas City has its boiler room somewhat removed and entirely underground, with a pipe tunnel to the building. Whatever the position of the boiler room there must be access way for bulky new equipment. Where coal is used, the coal pocket must be low enough to shoot coal into, and therefore it may require a traveling hoist to get the fuel out again.

Parenthetically it should be added that next to the boiler room is the best place for the refrigeration plant; but space for this plant should be cut off from the boiler space in order to avoid the hazard of refrigerant decomposition in case of a leak. Allowance should be made here for a plant equal to full air conditioning, even though all the required equipment may not be provided at once. Specifications for machinery rooms for refrigeration systems are given in the American Standards Association *B9 Safety Code*. The boiler room is the place also for the hot water supply boiler and storage tank, since at best the hot water supply is not taken from the boiler that heats the building.

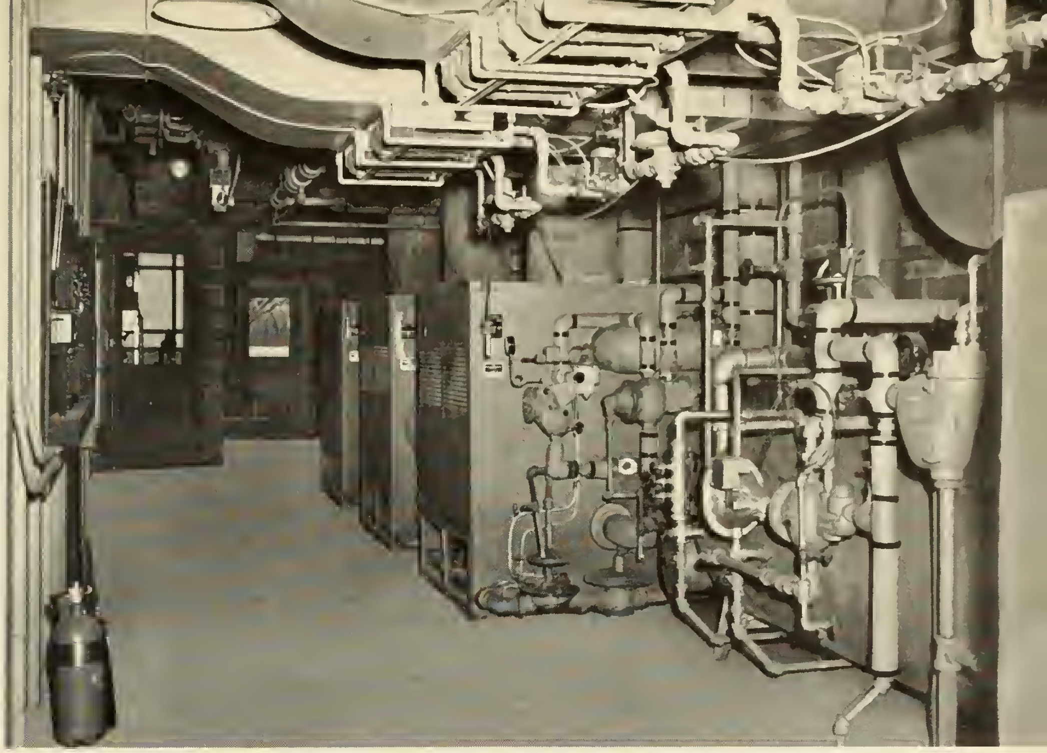
The boiler stack is likely to be a serious nuisance. At the California Palace, San Francisco, the flue goes 100 feet underground to a stack in a clump of trees; but elsewhere many an ordinary chimney is to be found. In recent years certain commercial and industrial installations have been made with fully automatic oil fired boilers having draft fans of such design that a chimney or stack is not needed to maintain proper draft conditions.

The Rochester Museum has *gas*-burning heaters, installed in a penthouse partly to save valuable space at low level. Only the small control panel is in the basement.

Coal has been the usual fuel in the past, and consequently a majority of existing museums have coal fired boilers. Automatic stokers are the rule; hand fired bituminous coal boilers and furnaces should be avoided because of the smoke they produce. Museum requirements of cleanliness are against the cheap grades of coal, although an automatic mechanical stoker and forced draught may make possible the use of low volatile bituminous as well as semianthracite coal. Where coal is used it should be checked for sulphur content since high sulphur coal produces sulphur dioxide which is injurious to collections. Recent developments in combustion equipment indicate that improved results can be anticipated from cheap coal and that less space will be required for the plant than in the past.

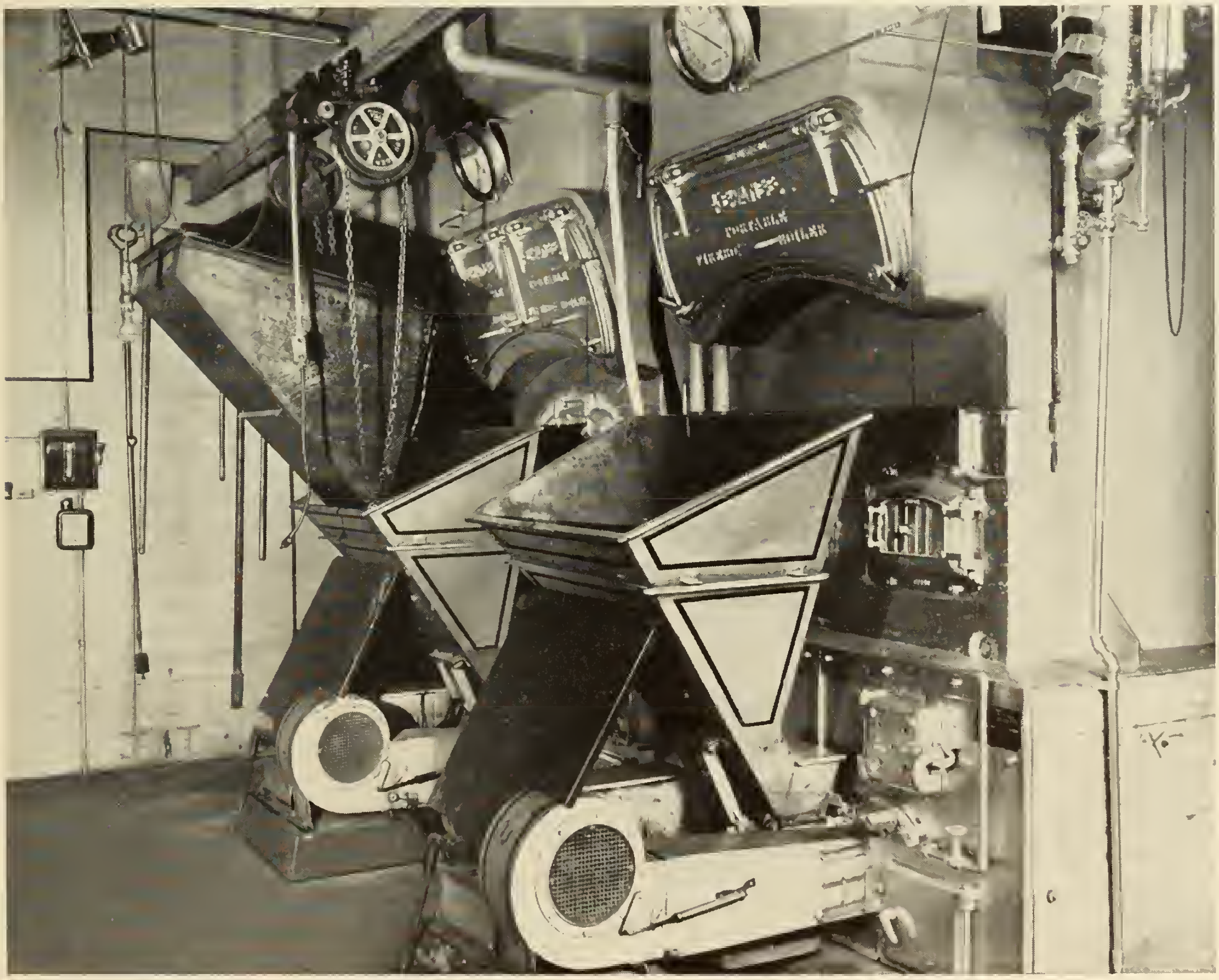
Oil is now the usual fuel, however; and most of the newer museum buildings have oil-fired boilers. Prices of oil depend on consumption demand in relation to supply, and therefore largely on the consumer's geographic location. In general, the East Coast pays more than the West Coast and Southwest. The commercial standards that specify grades of fuel oil have been changed recently. American Society of Testing Materials specification D 396-48 T, also published as Commercial Standard 12 of the U. S. Bureau of Standards, describes the following oils: No. 2. A distillate oil for general purpose domestic heating; No. 4. An oil for burner installations not equipped with preheating facilities; No. 5. A residual-type oil for burner installations equipped with preheating facilities; and No. 6. An oil for use in burners equipped with preheaters permitting a high-viscosity fuel. Museums ordinarily use middle grades: No. 4 and No. 5, except in small buildings having single or multiple installations of automatic oil-fired boilers and perhaps requiring No. 2. The possibility of employing multiple installations of low pressure boilers, which eliminate the necessity of constant attendance and often make other savings, although they may call for a better grade of fuel, should not be overlooked in buildings of medium and smaller size.

Gas-fired equipment is now coming into use and is proving very satisfactory. Natural gas, where obtainable, is a cheaper fuel; and its



GAS-FIRED HEATING PLANT IN PENTHOUSE OF ROCHESTER MUSUEM OF ARTS AND SCIENCES. THREE BRYANT STEAM BOILERS ARE FOR OFFICES AND SHOPS, AND AIR-CONDITIONING PLANT IS FOR EXHIBIT AREAS (RIGHT)

(BELOW) PORTABLE FIREBOX BOILERS AND COAL STOKERS AT CRANBROOK INSTITUTE OF SCIENCE. CONVERSION TO OIL POSSIBLE



use makes possible many operating economies. The Rochester Museum, consuming over a million cubic feet of gas at a cost of about $4,500 a year, eliminates four engineers' salaries through its one-man control, besides saving space, trouble with ashes, and the nuisances of dust, soot, and fumes. In this case, the plant has a device for shutting off fuel supply automatically and ejecting escaped gas if there is a leak. Among other users of gas are museums in Dallas, San Diego, Kansas City, and Colorado Springs.

Museum heating bills run from a few hundred dollars to well over $25,000 a year. Such substantial amounts, though taken for granted, point to the importance of considering carefully the heat conducting character of every new structure. Also they suggest that improved methods of heating new buildings might compensate in large measure for the cost of complete air conditioning.

Steam piping, which is a problem to the planner of buildings with radiators, is comparatively simple in an air-conditioned building, where steam is delivered to fan rooms. Many an older building is disfigured by the steam main, that often used to be hung from the basement ceiling. This hot and troublesome pipe is better placed in a service tunnel that circuits the basement under the floor or between double walls. Vertical shafts are provided for vertical pipes. But where there is air conditioning, problems of running ducts take the place of most problems of running pipes.

Radiators are not used at all in some of the recent air-conditioned buildings; but in other buildings, including many with air conditioning that was put in as a remodeling step, radiators are employed either as "boosters" for times of extreme cold, or as the only means of heating in conjunction with a duct system for circulating cleaned and humidified air (split system), or as means of heating offices and perhaps other room in buildings that have fully air-conditioned exhibition spaces (combination system). The most satisfactory plan is that of year-round full air conditioning, automatically controlled, for all parts of the building. This dispenses with radiators, even for spaces of extra heat and cold such as the vestibule and receiving room which may have local conditioning circuits or units of their own. The common idea that offices must be heated in winter but need not be cooled like other parts of the building in summer, is responsible for some combination systems that have caused no little regret.

The gradual disappearance of radiators is due to causes that have more force for museums than for other kinds of public buildings and much more force than for offices and homes. In exhibition rooms, radiators are unsightly and have long been in the way. If placed along walls they make the surfaces above them too hot, too dry, and too dirty for exhibits; and this is true whether the radiators are open or concealed, or of direct or convection type. Placed under windows to warm incoming chilled air, they point to need for better window construction and insulation, or else they mark places where unit heaters or local duct circuits might be installed to better advantage. Without other conditioning, heating is not enough for a building with crowds to be kept comfortable and unique material to be preserved; and where there is a system for air conditioning, the best way to heat is not by radiators but by central heating coils for ordinary conditions and extra heating coils in ducts at points of extra load.

Booster radiators, which come into action only when other heating fails to meet a drop in temperature, are much in use. However, compared to other means of doing the same thing, they must be judged in the light of the fact that boosters are really safety devices that nevertheless require all the provisions of a regular heating system. In some museums, as at Philadelphia, boosters are set for about 50°F and come into play only two or three times in an ordinary winter. Elsewhere they are set for higher temperatures and act more frequently, as at Worcester where they operate at 65°F. But in any case they are not used regularly and may therefore be out of order when they are needed most. Some superintendents prefer hand control because thermostats can fall down, whereas others trust to thermostats because hand control can fail them. If booster radiators are employed, they should have both automatic controls and provision for frequent tests of the system's performance.

Unit steam heaters, with fan attachments, are essentially special radiators for particular purposes such as warming a receiving room at times of truck deliveries in cold weather. Using them instead of regular radiators throughout the building, as some small museums do, and as one great museum has considered doing in extensive remodeling, is like making a costly gesture at air conditioning without promise of the results that conditioning should give. If heating is what is wanted, radiators are fully equal to it. Ventilation is something that no fan units can achieve with their stirring of the air. Where unit heaters are wanted for their legitimate, only occasional, use, electric units are likely to be more advantageous than steam units because of the greater initial economy and ease of installing them. The New York Historical Society has a unit of this kind to be turned on when required in the service area. However, electric units are expensive to operate, and if they are run for long periods this is a serious count against them.

Radiant heating, whether by steam or hot water supplied to pipes imbedded in floors or walls, is a method that museums have not adopted until recently. In fact, the new Des Moines Art Center (1948) seems to be the first with this type of heating. Here two galleries have hot water pipes in their floors, under travertine flooring in one room and wood flooring in the other. Each room is individually controlled, like three other zones in the building which however are heated by hot water radiators. In general, radiant heating is not adaptable to full air conditioning except as a supplementary heat source; and at Des Moines the radiant heating serves the air conditioning system in essentially this way even though the air conditioning plant is called upon only at times, for the galleries, to do its work of preheating and circulating air under humidity control.

Radiant heating may entail relatively low first cost if the floor is constructed directly on the ground—a condition ordinarily not desirable in a museum. Also it does away with need for radiators, and requires no visible appurtenances in rooms. If properly designed it assures small temperature fluctuation, with attendant comfort; and because of its high heat storage it permits quick return to normal when temperature is disturbed. But, on the other hand, its control problems are difficult, especially at times of mild weather.

VENTILATION may be natural or forced. Forced ventilation, or the supply and removal of air by mechanical means, is associated for the most part with heating and other conditioning, although some forced movement of air is independent of this. Natural ventilation, which goes on to some extent in every building, is not welcome in the presence of air conditioning if only because flow of air from outside means ingress of dust.

Exhaust fans commonly operate as independent units. They may be installed, for example, in attics to pull outside air through spaces above skylights. Some museums thus force filtered air through their attics in summer at rates up to several hundred thousand cubic feet a minute; and summer temperature in the tops of the buildings may be reduced in this way from staggering extremes to the neighborhood of 100°F. Some little museums with no other cooling provisions draw air through their buildings and blow it out by means of attic fans. Also in many buildings fans stand ready to change the air in small auditoriums, kitchenettes, shops, storerooms, and toilet rooms. For such purposes, axial flow, or propeller-like, fans that can be set in walls are commonest, though they may be noisy. Radial flow, or centrifugal, fans are often better, especially since they may be placed at a distance from rooms in which silence is wanted, and connected by duct. Fan selection is an engineering problem, and should not be undertaken without informed advice. As a measure of fire protection, there should be ready means of stopping fans.

Unit ventilators for individual spaces are factory-built assemblies of heating as well as ventilating equipment; and the term is often applied still more loosely to units for complete air conditioning, discussed in the following section. Heating ventilating units are good for isolated critical points that need only warming and air change. For an entire building they are collectively more costly than a central system.

A central system for ventilation and preheating, without cooling and humidity control, must be regarded as inadequate. Where such a partial system is installed, the ducts should be designed for complete conditioning—which means full coverage of the building, with ducts properly installed, and vents placed for supply at the top and exhaust at the bottom of each room (contrary to the scheme for circulation of merely preheated air). Also space should be set aside for all the necessary central air conditioning equipment, including space in the basement for heavy refrigerating machinery and perhaps elsewhere for air handling and heat transfer equipment.

Natural ventilation, as mentioned above, is important only if there is no central forced circulation of filtered air. If air is filtered, natural ventilation defeats the cleaning process. Many large museums that were built in past decades still put faith in natural air drift under wind pressure and in the self-ventilating capacities of open space; but such apparently free benefits do not protect museum collections from dryness in winter or moisture in summer, or from year-round dirt and sulphur dioxide fumes of smoky cities. Natural ventilation makes some buildings habitable, but it cannot fully relieve discomfort from stuffiness and from heat in season. No new building designed as a home for museum work should be without the vital equipment which has helped to make up-to-date museums what they are by dint of its assistance to functional planning.

AIR CONDITIONING is "the process by which simultaneously the temperature, moisture content, movement, and quality of the air in enclosed spaces intended for human occupancy may be maintained within required limits," according to the *Heating Ventilating Air Conditioning Guide*. For anyone considering this subject with an architect or engineering consultant, the *Guide* is a helpful handbook; it is republished each year by the American Society of Heating and Ventilating Engineers, New York. A good simple text to go with it is *Practical Air Conditioning* by A. J. Rummel and L. O. Vogelsang (John Wiley and Sons, 1941).

Air conditioning practice varies considerably, but in general the process consists of taking outside air to circulate and perhaps recirculate after it has been filtered and treated to correct its temperature and humidity. These last steps change with season. In cold weather the filtered air is passed over steam coils and through humidifying sprays, but in warm weather it is cooled and has some of its water vapor removed by condensation as it passes over cooling coils or through a cooling spray. This takes for granted the boiler equipment that makes steam for the coils in winter and in some cases for turbines and other machines throughout the year; it skips over the refrigeration plant that chills fluid for the coils or the sprays in summer; and it presupposes the usual public utility supply of electrical energy to run motors for fans and the like. However, divested of questions touching the source and final destination of heat and the sources of power, and divested of problems as to the design and choice of equipment, this is how air is conditioned. Although the term is often used loosely to embrace only part of this set of procedures, air conditioning is in fact no less than year-round control of the temperature and moisture content of cleaned air that is moved through a building.

There are two ultimate objectives of air conditioning in museums, namely, comfort of visitors and employees, and conservation of collections. Both ends are of great, and ever growing, importance. In some climates there are seasons when outdoor air may be about right for museums; but in most parts of this country the times of such conditions are of short duration. Everywhere, good seasons alternate with seasons in which conditioning for comfort may be very needful, and conditioning for conservation (that can have no lapses without risk of lasting damage) may be truly imperative.

Possibilities of harm to museum materials are many, as indicated in Chapter 75 of *Refrigeration Application* published in 1946 by the American Society of Refrigerating Engineers. Besides adverse temperature and humidity conditions, common causes of deterioration are the work of light, dust, air pollution, and to some extent impurities in materials themselves. Adequate air conditioning retards or eliminates shrinking, bulging, warping, and cracking that may come from temperature and humidity changes, while it also stands in the way of such swift harm as actual condensation might cause. Further, it keeps out dust that might otherwise cause damage; heads off discoloration, the brown blotches known as "foxing," and growth of mold, mildew, and fungus. It prevents substances from brittling, decaying and softening, and lengthens the life of adhesives. It protects against damage due to sulphur dioxide, and minimizes tarnishing of silver, and surface changes in iron, copper and other metals. In short, any museum with important collections to preserve must either meet the cost of air conditioning or neglect a duty toward its charges.

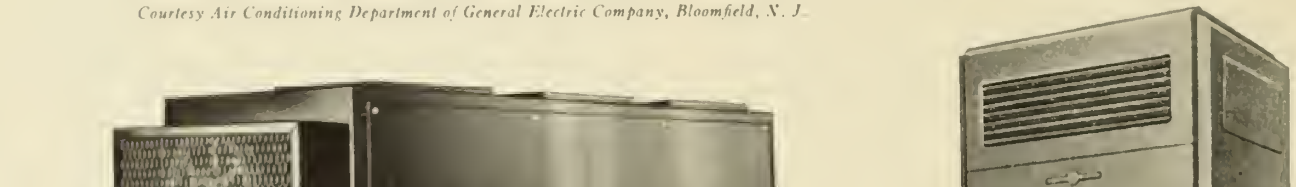
At seasons of problem weather, if not all the time, every museum must face also the modern public's expectation of indoor comfort. This is a complicated matter in human terms, but for the museum it means cooling in summer as well as heating in winter, and equally it means year-round control of humidity and removal of dust and odors.

The cost of air conditioning is commonly supposed to be prohibitive because it has been judged so often in the past as the cost of installing and running an accessory plant for summer conditioning in a building not designed to assist this purpose and in the presence of heating installations that do not lend themselves to adding other equipment. If the cost of year-round air conditioning for a new building is considered in relation to the cost of admittedly necessary winter conditioning—that is heating, with cleaning, humidification and forced ventilation, all of which are not thought prohibitive because they are now rarely dispensed with—the cost compares favorably with more usual items. Nor should it be overlooked that the cost is mitigated by savings that full conditioning makes possible in rehabilitation of collections and other property and in the usually substantial cost of cleaning in the museum. "Our analysis," says an engineer, "indicates that a museum can own and operate air conditioning at an annual cost equal to or less than these savings." (J. F. Kooistra in *The Museum News*, May 15, 1941.) Besides, full air conditioning is getting to be a little like water supply for a swimming pool; you practically have to have it.

Initial outlay for an all-year complete conditioning plant in a new building runs below 10 percent of total building cost as a rule (Table V, page 43). Data obtainable from museums do not permit of separating costs of winter and summer conditioning equipment; but it appears that most museums have employed less than the refrigeration capacity that engineers assume by rule of thumb for a commercial building before calculating the cooling load exactly. This rough assumption

COMPACT YEAR-ROUND AIR CONDITIONERS SUITABLE FOR SMALL MUSEUM BUILDINGS (RIGHT) GENERAL ELECTRIC PACKAGED AIR CONDITIONER TYPE FD-30D OF 3 TONS CAPACITY. (LEFT) G. E. CENTRAL PLANT CONDITIONER TYPE HDV, 2 TO 40 TONS.

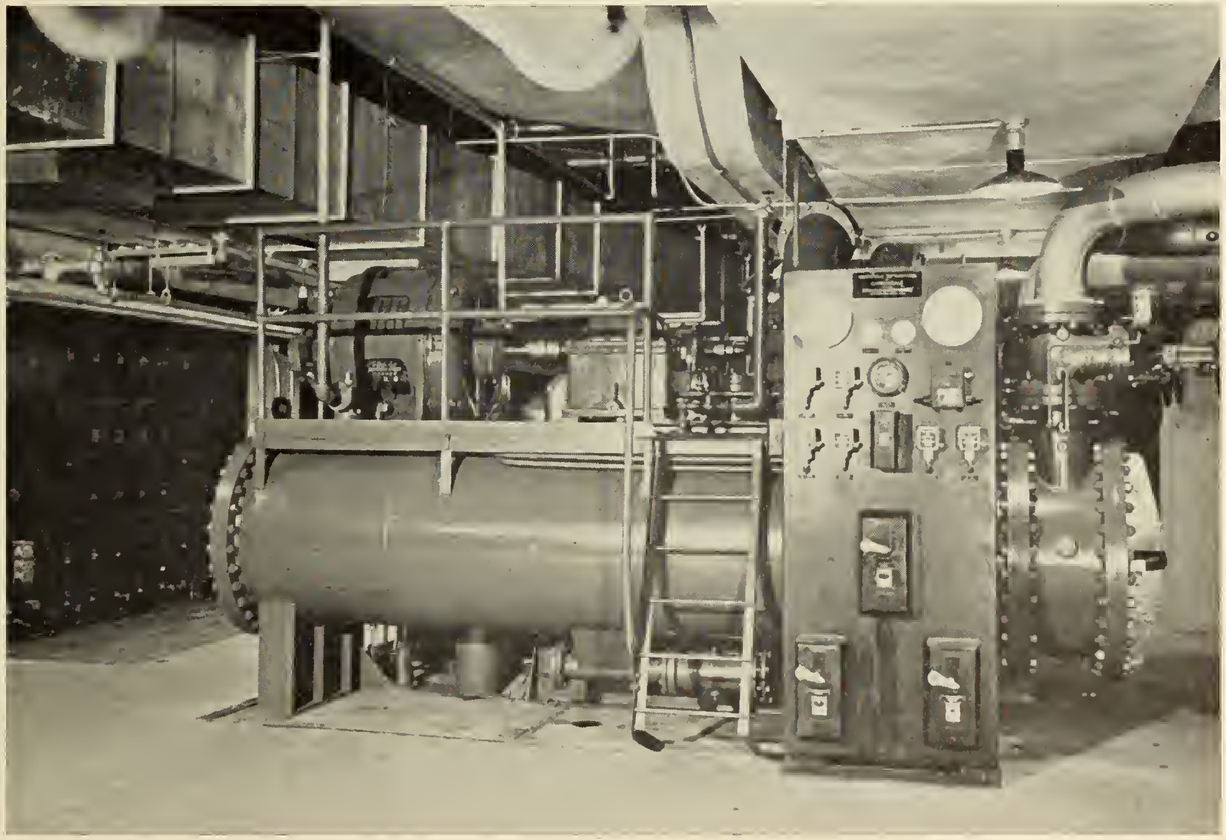
Courtesy Air Conditioning Department of General Electric Company, Bloomfield, N. J.



calls for one ton of refrigeration for each 4,000 cubic feet of space, or for each 200 to 400 square feet of floor area. A "ton" of refrigeration, by the way, is what will remove enough heat to melt a ton of ice in 24 hours—technically, 12,000 Btu (British thermal units) per hour. Under recent price conditions the initial cost of a small plant, say of 3 to 5 tons, for summer conditioning of a little building would probably have been upwards of $400 a ton; and the cost of larger plants for bigger buildings $600 or more a ton; prices in 1950, it should be added, are at least 25 percent higher. The plant capacity at the National Gallery, the highest in any museum, is 1740 tons. The cost of equipment and installation is, in general, considerably greater for a building of monumental character than for a simple structure. Also, where a plant has to be installed in an existing building, the architectural treatment may lead to extra difficulties and attendant extra costs.

The tendency to put in equipment not fully equal to the job is shortsighted, since efforts to patch a system after it is installed are both expensive and unsatisfactory. Directors of two recent buildings have recorded complaints of their inability to meet the cooling load imposed by exhibition lighting and occupancy in summer, although their buildings were supposedly designed to have adequate year-round conditioning. The cooling load increases, naturally, as the use of the building increases; and future requirements

CENTRAL HEATING AND TEMPERATURE CONTROL ROOM IN A LARGE MUSEUM BUILDING. PART OF THE YEAR-ROUND CONDITIONING PLANT OF THE NATIONAL GALLERY OF ART



should be estimated realistically when the plant is designed.

Operating cost of year-round conditioning depends, naturally, upon the severity and duration of heat and cold in the summer and winter season; and it varies largely with the size and type of the building and its mechanical plant, and also with the skill of operation. For equal lengths of hot and cold weather in many parts of the country, summer cooling and winter heating bills seem to run neck and neck. Total museum expenditures for year-round conditioning are from less than $500 to more than $50,000.

The cost of refrigeration for summer conditioning runs from about $15 a ton in a very large building to nearly $50 a ton in a little building. Stated otherwise, to take climate into the picture, the period of cooling each year may be from as few as 500 hours to as many as 1500 or 2000 hours, and the cost of refrigeration per hour for each ton of full plant capacity varies from about 1½ cents to 3, 4, or even 5 cents depending on the size of the system and the locality. Capacities of plants in museums range from under 5 to over 1700 tons, as noted above.

In keeping down cost, one of the largest opportunities for savings is in electric power for motors, and watching this means especially watching peaks of load. The system should be designed to meet any reasonable load, but peaks should be avoided because they establish the demand which the utility company must be prepared to meet and for which it charges. Thus a single quarter-hour of excessive power consumption can increase the rate on all power. It is important, in consequence of this, to keep conditions in the building right at all times rather than to let them get out of hand and then have to restore them. Uninterrupted automatic control is the best assurance of even performance; and this should govern both the central system and auxiliary units for points of especially high or sporadic load. The large results that operating skill can produce point also to the importance of designing the building to favor conditioning rather than in a way that makes it more costly and difficult. Building design and construction that prevent access and escape of heat can make savings in year-round power, if not in winter's fuel alone, sufficient to bring full air conditioning within very much easier reach.

The conditions to be maintained for comfort within a building depend in part upon the outside climatic conditions. In warm weather one would be chilled by an indoor temperature that would seem all right in cold weather. Studies by the American Society of Heating and Ventilating Engineers have determined optimum conditions for all seasons in terms of a so-called "effective temperature index" expressing combinations of temperature, humidity, and air movement that lead to a feeling of comfort on the part of people used to common weather conditions in the United States (*How to Use the Effective Temperature and Comfort Charts*. A.S.H.V.E. *Transactions*, Vol. 38, 1932). These investigations (summarized in the A.S.H.V.E. *Guide* referred to above) point to *effective* temperatures of 71°F in summer and of 66°F in winter as optimum—these effective temperatures being equivalent to ordinary thermometer readings of 76°F in summer and 70°F in winter when measured at 50 percent relative humidity and with an air movement between 15 and 25 feet a minute. However, it must be noted that relative humidity, or the extent to which air is saturated with water vapor, cannot well be held at 50 percent in winter, desirable as it is to do so, unless the building has double glazed or otherwise insulated windows or no windows. At 50 percent relative humidity water vapor is likely to condense on single window panes.

Museums hew close to these lines. For example, the National Gallery maintains temperatures between 68 and 70 degrees in winter and between 70 and 80 degrees in summer, with 50 percent relative humidity throughout the year and an appropriate movement of air. However, in museums, as in other buildings with people going and coming, there has to be some adjustment to climate. Thus, the Frick Collection and the Museum of Modern Art in New York keep to a year-round temperature of about 72 degrees, except in very hot spells when somewhat higher temperatures (10 degrees less than outside) are set for short periods. British observers, for their climate and habits of dress, recommend indoor temperatures in the neighborhood of 62–64 degrees in winter and 66 degrees in summer (S.F. Markham. *Climate and the Energy of Nations*. Oxford University Press, 1944).

Although we know what conditions people need for comfort, we do not have certain knowledge as to the requirements of collections. For book storages, the U. S. Bureau of Standards in a *Summary Report . . . on Preservation of Records* (Miscellaneous Publication M 154, 1937, page 27) recommends temperatures of 70°F in winter and 80°F in summer, with relative humidity of 55 percent throughout the year. However, for museum materials it has always been assumed that constant conditions are best, although different kinds of material may, and probably do,

A FAN ROOM IN THE NATIONAL GALLERY OF ART, WASHINGTON, D. C. CENTRIFUGAL TYPE BLOWERS DISTRIBUTE THE FILTERED AND ADJUSTED AIR TO GALLERIES ABOVE

have different requirements. Moreover, relative humidity of even 55 percent may be impractical for winter operation except in buildings designed for conditioning.

In the face of this mixed situation, museums have settled on the above-indicated conditions. These conditions can be maintained without too much difficulty, and are agreeable to visitors and staff; and they represent a great improvement on what most collections would otherwise be exposed to. Suggestions as to segregating collections into high and low humidity groups have been rejected as unworkable, partly because such differences might bring about condensation at critical points.

CONDITIONING PROCESSES, as we have seen, go in sets. There is year-round cleaning and moving of air, winter heating and humidifying, and summer cooling and dehumidifying. Although they are automatically controlled, these processes have to be watched over; and they may have to be taken in hand at special times, as when heavy loads are imposed. Also, in spring and fall one must intervene to change over from winter to summer conditioning and back again.

Cleaning air is a process of removing dust as well as any harmful fumes or unpleasant odors. This is an urgent matter for every museum, as much for conservation as for comfort. Incidentally, dust removal is necessary also as a means of keeping the heating and cooling plant in good working condition.

Dust and soot are removed from the air by filters—either viscous medium (oil coated) filters or dry filters, both of which kinds are in museum use. Viscous filters are usually of the kind to be turned automatically through a pool of oil, although there are also throw-away viscous filters for small installations. Dry filters, of paper or other fibrous substance, are usually thrown away after use. If viscous medium filters have the defect of releasing oil particles into the air they are treating, as one hears, this may be due to forcing air through them at a speed greater than they are designed for. But some museums, not wanting to take any chance, have adopted dry filters. For certain commercial purposes spray filters are best; but sprays have low efficiency in dust removal, and they are used by museums not for filtering but for other purposes as we shall see below. There is also an electrostatic dust-precipitation process, adopted apparently by only one museum (Chicago Art Institute) in conjunction with viscous filters for a very acute smoke problem. Electrostatic precipitation is especially successful for fine particles of dust, which recommends it to museums.

For winter removal of sulphur dioxide gas from the air of smoke filled cities, reliance is placed on an alkali dissolved in the water of humidifying sprays. Sodium salts are approved by the U. S. Bureau of Standards (Miscellaneous Publication M 142, 1933). The National Gallery follows this practice during months of fuel burning, even in non-industrial Washington. For some locations, as near a railroad or factory, the same treatment of the cooling spray might be necessary in summer. Sulphur dioxide in the presence of moisture can be very harmful to some kinds of museum objects.

To remove odors for which museum visitors are responsible ("reflecting their socio-economic status," according to one very well posted source) the usual treatment is to keep the air changing and to add a sufficient amount of fresh air from outside.

Other common processes little found in museums are the exposure in the air stream of activated carbon to absorb organic vapors, ionization and ozonation to approximate the invigorating qualities of outdoor air (ionization being employed with dust precipitation at Chicago), and use of ultra violet light to kill microorganisms—this last, by the way, being introduced in many commercial uses as a part of lighting rather than of air conditioning.

Heating and humidifying, in winter months, is accomplished by centrally placed steam coils accompanied by sprays, all in sheet metal housing through which the air stream is forced on its way to distributing ducts. The steam coils, of copper tubing, have metal fins to increase their hot surface presented to the passing air. Sometimes there are preheating and reheating coils, placed before and after the spray. Also, the spray may be replaced by an atomizer or steam jet device; but most museums use sprays.

Although preheating of air for circulation is the heating method that goes with full conditioning, buildings with equipment put in at different times are likely to have heating by a central boiler and radiators and other conditioning by appropriate central equipment and ducts. Such a double system is a makeshift, and it reflects the newness of full air conditioning.

Cooling and dehumidifying are accomplished together, usually by means of a cold spray, as we have also noted, but sometimes by means of cold coils; the use of coils for this purpose is comparatively new and as a rule it lends itself best to fairly small buildings. Cooling without moisture removal is not feasible in most climates since the cooling of air reduces its capacity to hold water as vapor and thus increases its relative humidity, producing discomfort for people and perhaps harm to property. Also cooling without removing moisture leaves air nearer to its dew-point, at which point there can be wholly unauthorized condensation if the air happens to be further chilled as by coming into contact with some colder surface. Summer conditioning therefore removes both the so-called sensible heat, so making the air feel cooler, and the latent heat, so enabling humidity to run off harmlessly either into pans under cooling coils or with the water of cooling sprays. Usually after the air has been cooled enough to get rid of all but the needed water vapor, it is warmed a little by mixing it with some warmer used air that has been filtered for recirculation. Under automatic control these steps are taken in such a way as to give the end temperature and humidity desired after the air has adjusted itself to the room in which it is used.

The equipment employed for summer conditioning, whether by sprays or coils, is in the same housing as that employed for winter conditioning, and air is moved past it in the same way throughout the year. If there is an available supply of very cold water, as from an artesian well, this may be used in the cooling coils or sprays, thereby much reducing the trouble and cost of summer conditioning. Portland, Oregon, has a city water supply cold enough for this purpose; but most places do not, and are obliged themselves to chill the water used in sprays, or the water or other medium used in coils.

For this chilling of the medium, refrigeration equipment is necessary. There are several methods in museum use, but the usual one employs a mechanical process and a refrigerant. The refrigerant alternates between liquid and gaseous states as it circulates through the equipment. It enters the cooling coils (or the cooler of the water supply for sprays) as a liquid; but it evaporates as it gathers up heat, and passes on as a superheated gas. It then enters a condenser where its heat is released and it becomes a liquid again. The released heat is sent to the out-of-doors, as we shall see presently. The refrigerant used in most cases is known by the trade name of *Freon*, a substance developed through research on fire hazards, odor and toxic effects, corrosive properties, and various operating factors including cost, as a substitute for the older carbon dioxide and ammonia. Incidentally, a method of cooling water for coils or sprays directly by means of a centrifugal type compressor is employed at Kansas City; but this equipment is no longer produced, and other systems using water as refrigerant are rarely seen and apparently are not found at all in museums.

For the final dismissal of the heat to nature, after the refrigerant has released it to water in the condenser, there may be a tower on the roof where breezes and forced air currents can cool while they evaporate (Museum of Modern Art); or there may be a system of pipes for city water to bathe on its way to the sewer (Des Moines Art Center) or for some natural stream of water to pass over (National Gallery, sharing with nearby buildings a piped underground stream from Washington tidal basin to harbor).

Making air move within a building from the intake through the conditioning apparatus, by way of a system of distribution ducts to the space where the air is used, and on through ducts to the exhaust, with more or less recirculation, is the work of motor-driven fans. The air may be moved in one ramifying and rejoining stream by central machinery; or it may be moved in several independent streams, for different parts of the building, each with its own fan room and all served by a central boiler and refrigeration plant. In a very small building, or in some special room of a larger building, air may be conditioned in the place where it is used; and the moving of the air may then be a local task performed by the local conditioning unit itself. Fans, or blowers, have to work most of the time to keep air in motion, although under some conditions a system of ducts will ventilate gently by gravitation alone.

The type of fan most used in air conditioning is the radial flow, or centrifugal, type which takes in air at one side and whirls it off from the blades of a sort of paddle wheel into a spiral casing that leads to a duct. Such fans pull air through filters, coils, and sprays and push it on into the ducts that distribute it through the building.

Space for ducts is provided within walls and above hung ceilings. Ducts should not be run in vertical risers between double walls or beside stair towers or elevator shafts unless they are encased in 4-inch hollow tile and are provided with automatic fire dampers at each horizontal take-off, as required by regulations of the National Board of Fire Underwriters' *Pamphlet* No. 90. The main intake and exhaust are often at the top of the building, with fan rooms close at hand on the roof; but if the openings are above and fan rooms below, there must be space allowance for a vertical trunkline duct connecting them. The intake and exhaust should be screened against insects and birds.

As a rule each room or other conditioned space unit has its own air supplies and exhausts; but sometimes one stream of air goes through a suite of rooms, or from several rooms to a corridor or lobby, and is then discharged. The latter scheme tends to make draughts, but it may be very useful where flexibility of exhibition space for rearrangement is required. Holes in walls to assist air flow from room to room are unsightly and inconvenient, and their use is discouraged. Whatever the method of distribution, it is usual to maintain a slight pressure throughout a building so that a little air will escape through doors and other leakage points to prevent unfiltered outside air from getting in. On the other hand, excessive pressure may have to be avoided in large occupancy buildings by use of an air exhaust fan to help balance the introduction of air through supply ducts.

Air motion in a room has to be sufficient to bring in conditioned air and to remove used air with its unbalanced load of heat. Also it has its part to perform in directly producing certain comfort conditions. In the latter role, the function of moving air is not to fan people but to contribute toward conditions under which the human body can control its own temperature. Air flow of 20 to 25 feet a minute is about right; velocity over 50 feet a minute is undesirable except perhaps in the absence of sufficient refrigeration. Currents emerging from ducts may sometimes move at 200 or more feet a minute without causing trouble, but these must be high in the room. Streams in ducts sometimes rush at upwards of 600 feet a minute in branches and at 1200 to even 1600 feet a minute in main lines. The number of changes of air required in a room depends largely upon the number of people present, and may be from about one change in two hours to ten changes an hour. Ordinarily five or less changes an hour are sufficient. The amount of air that has to be moved for heat and moisture removal in summer is several times as great as that required for ventilation alone. Ducts should be of generous size, if only so that the system will not have to be pushed to full capacity with attendant humming of fans and wheezing of air currents.

OVERHEAD DISTRIBUTORS OF INCOMING AIR DIRECT DOWNWARD CURRENTS AWAY FROM POINTS BELOW

Courtesy William Rockhill Nelson Gallery of Art, Kansas City

Courtesy National Gallery of Art

GRILLES MARK POINTS AT WHICH DUCTS REMOVE USED AIR FOR DISCHARGE OR RECONDITIONING. AIR ENTERS NEAR CEILING

Elimination of sounds is important. This should be considered in advance, because it depends largely upon engineering design of ducts and their openings. Air conditioning has to its credit the fact that closed windows keep out many street noises; but it may spoil this record through neglect of vibration-proofing for moving machinery, and acoustic installing of ducts with cushion holders, protective coverings, and perhaps lining in parts of the system. Sounds inside the building that the air ducts may carry (such as the engineer's language or the sump pump's sudden thumps when a speaker is being presented in the lecture hall) are separate problems that have to be solved by themselves.

Air is supplied to a room through grilled openings high in walls (not so near ceilings that dirty streaks will appear) or through overhead ceiling openings fitted with air diffusers. It is taken out through grilled vents in walls near the floor. Before the days of summer conditioning, it was usual to introduce air near the floor and take it out near the ceiling, and this practice in museums led to the once familiar arrangement of exhaust vents in borders of skylights. But now, with year-round conditioning, the reverse practice is followed, air entering at the top and leaving at the bottom, since this keeps incoming cool air from collecting on the floor in summer, without hampering the movement of warm air in winter. Nevertheless, where artificial lighting creates an excessive heat load high in the room, some air may well be taken out (in the season when heat is not wanted) from the immediate neighborhood of the lighting fixtures. Where air is made to pass through a workroom, live storage, or bookstacks, care should be taken not to make draughts along aisles or through passages.

The design and placing of air openings and their grilles or other covers should have attention of both the architect and the engineer. Openings are arranged to bring about proper movement of the air mass in the room—over

CONTROL BOARD FOR ALL-YEAR CONDITIONING PLANT

Copyright The Frick Collection, New York and under, around, across, or in breaking currents, according to the shape and size of the space. There are standard types of vents and grilles on the market, but special types are frequently required. Inlets may be in sight or concealed. If inlets are in the ceiling, air diffusers are usually employed to keep currents from impinging on people's heads; and for this purpose there are familiar patented types of diffusers on the order of the *Anemostats* installed in the Museum of Modern Art. The fireplaces of period rooms are sometimes used as exhausts. A combination of vent and lighting fixture has been contrived by the Art Institute of Chicago for its Allerton Wing. Exhaust grilles may well be placed in doorway reveals, but putting them in the ends of gallery benches is not practical since it robs the room of flexibility.

After air has been used and drawn off, it may still be retained in the system. Compared with outside air, the air returning from rooms is likely to be more nearly what is wanted in its temperature and humidity, though it doubtless needs to be refiltered and perhaps mixed with some new air to freshen it. At times, especially in spring and fall, air may advantageously be run right through the system and out, and at other seasons a flushing may be needed from time to time. Also certain spaces, such as toilet rooms and kitchens, must be separately flushed at all times by an independent fan unit. But ordinarily returning air is fed back to the incoming stream of air ahead of the filters and is recirculated. Dampers under automatic control are used to mix the two streams in the right proportions. About one part of fresh to three parts of used air is a common mixture.

Control of all processes should be automatic. Remote control of valves, dampers, fan motors, and certain other apparatus is exercised by thermostats and humidistats in the conditioned rooms. Other devices within the central plant take charge of temperatures, pressures, fluid levels, and other conditions required by the apparatus, and give signals if things go wrong. These controls may be electric or pneumatic.

Thermostats in the conditioned spaces should be placed where they do not clutter exhibition walls, and where they can take note of what goes on in the room and make the plant behave accordingly. A very good position is at the mouths of exhaust ducts, just behind the grilles.

DESIGNING THE SYSTEM is work for a consulting engineer in cooperation with the architect. The engineer should be included in discussions from the start to avoid irreparable missteps. If the engineer is called in after the building is partly completed he is likely to find that spaces assigned to the physical plant are too low, too small, or disadvantageously placed. Moreover, engineering requirements as to types of equipment, accommodation of pipes and ducts, placing of outlets, and the like are matters that may deeply affect the entire design of the building. And many details such as insulation of walls, and double glazing or other insulation of light openings can be neglected only at great penalty.

The type of system adopted hinges on many technical considerations. Two extreme plans for layout of equipment are those of the central system sending air through distributing ducts to the scattered spaces, and the unitary system having a number of more or less self-sufficient compact assemblies each directly in the space it serves. Between these extremes there are various systems that divide their apparatus differently between a central boiler-refrigeration plant and scattered stations. A separate fan room simplifies the duct problem—especially if the fan room is one of several, each located near the zone it supplies and each getting steam in winter and chilled medium in summer from the central plant.

Zoning meets the problem of adjusting service to disparate conditions in different parts of a building, and also it is helpful in taking care of load variations as the sun changes its position or there are occupancy shifts. For high buildings, that may be restricted by building laws in the matter of how far expansion refrigerant can be piped, the piping of chilled water to the fan rooms of zones at different levels provides a way of avoiding high stands of air ducts with attendant engineering difficulty and loss of space. In small buildings a consolidated central plant is usually best, unless a unitary scheme is adopted for reasons of economy. A building of intermediate size may have its boiler-refrigeration space in the basement, and its fan room on the roof or elsewhere to make the best use of space. A large building may be zoned by floors or wings or both, and may have several fan rooms at appropriate scattered points. And any museum, small or large, may have additional units for the vestibule, receiving room, and other critical places. The National Gallery has a central plant, 21 fan rooms each below a group of galleries, and also five lobby units.

So closely interwoven are the problems of space organization and air conditioning, that engineering considerations may increasingly overrule designs for low spread-out buildings, groupings of small separated parts, and other plans that give a large perimeter relative to volume enclosed. For the weighing of such matters it is important that the building committee determine in advance the limits of temperature and humidity within which control is to be exercised, estimate conditions of occupancy, and arrive at other basic decisions. If more of a plant is needed than the building fund can provide, or if future additions are planned, there should be initial allowances of space for central equipment and an adequate and properly arranged installation of ducts. Extra-large heating coils, and other apparatus of more than the capacity needed at first, may also be indicated. Failing to exercise such foresight, the committee will seriously interfere with the museum's future.

As a postscript to this discussion, it may be of interest that the Franklin Institute, a museum of applied science in Philadelphia, treats its central air conditioning plant as part of a working exhibit. Through basement glass partitions, on which expository labels are posted, the public may "see and study the electrical, ventilating, elevator and other machinery necessary to the everyday life of a great building."

CHAPTER XIX. CONSTRUCTION, EQUIPMENT

The building committee very commonly has to consider construction and equipment during the course of work that leads up to the final structural plans and to the plumbing, electrical, and heating and air conditioning plans of the building. The architect and engineers have the technical side in hand, but they should look to the committee for many a lay decision. A sort of topical review of these and other matters can be found in the index of the present volume, which has been prepared to serve in part as a check list.

FIREPROOF CONSTRUCTION is imperative. To be sure, many temporary museum homes and also some small permanent museum buildings are of perishable construction; but any museum with irreplacable collections is entitled to a fireproof structure.

Because of its inflammable contents, no museum can be protected with certainty against the start of fire inside; nor are surroundings always such as to remove external fire hazards. However, suitable fireproof construction (that is, construction of 4-hour fire-resistance by underwriters' standards) can prevent the spread of fire. This calls for a reinforced concrete frame, with all members appropriately protected by means of concrete or masonry, or otherwise fireproofed, and also for fireproof floors, walls, and roof, and as much highly fire-resistive interior finish as museum purposes can accept. Fire protection should be considered fully in relation to plans as well as to construction since arrangement of spaces has a great deal to do with hazards. For guidance, the building committee should have the *Building Code* recommended by the National Board of Fire Underwriters, New York, as well as a copy of the building law to which the museum is subject. A few matters of fire prevention are considered elsewhere—in connection with exhibition walls (page 151), service quarters (Chapter XVII), air conditioning (Chapter XVIII), and equipment (sections below).

Akin to fire protection is the matter of constructing against the *hazards of war*—and, in some parts of the country, against the hazards of *earthquake*. Experience, all too familiar, has shown that damage from direct bombing is both inescapable where hits occur, and much less widespread than damage from fragmentation and fire. Breakage caused by concussion is best avoided through not having excessive overhead areas of glass or other construction with a small margin of safety. And secondary damage from fire is minimized by the fireproof structure that a museum should have in any case. If there is immediate war danger, further steps such as emergency propping against debris loads, exterior sandbagging, blocking of openings, and use of reinforced concrete slabs to shield points of extra vulnerability inside and out, would be taken. "To seek a greater degree of protection, as from a direct hit . . . , requires a type of construction that has been generally regarded as prohibitive in cost for any large-scale operation," says the National Archives in its *Bulletin* 6 (1944) on *Buildings and Equipment for Archives*. One New York museum built storages to several stories below street level—in wartime, and perhaps with thought of war hazards—but the general conclusion from experience seems to be that buildings should be designed and constructed to minimize their fire and other peacetime hazards, leaving the added hazards of war to be dealt with on an emergency basis.

The Huntington Art Gallery at San Marino, California, seems to have given more attention than any other museum to building for strains of *earth movement*, by cross-bracing the steel and reinforced concrete frame, making walls 16 inches thick in the basement to give weight and solidity at the bottom, tapering the walls to 9 inches thick at the main floor level for lightness in upper parts, and finishing with expanded metal under plaster to minimize crumbling. The greatest remaining hazard is in the skylights.

FOUNDATION AND BASEMENT construction is of major concern to the building committee because this must provide a sound and also dry lower part of the building. Ordinary structural adequacy, with all its importance, is but a half-measure without completely effective damp-proofing.

In choosing a site, dry and well drained land should be sought. However, even normally dry earth acquires moisture at times, and a basement floor or walls in contact with it will take up moisture and become damp throughout. Not only does such slight dampness keep paint from holding on a cement basement floor, but it contributes to possibly unallowable humidity in the building. On any site, foundation walls require at least routine damp-proofing, and on a wet site they call for special protective measures.

Building on a site with excessively moist or marshy land is not recommended because of the high cost of concrete foundations on a system of concrete or other piling. If ground water is encountered, the ground floor should be a structural slab well reinforced with steel. To this an impervious membrane should be applied, and on the membrane in turn there should be 2½ inches of concrete reinforced with mesh. Some museums have a sump pump in the deepest part of the basement to take out any water that may penetrate.

Even where there are favorably dry soil conditions the basement or sub-basement floor should rest not directly on the soil but on a 9-inch layer of broken stone, slag, or gravel under the cement. Basement foundation walls should be pargeted with ¾ inch or more of cement grout and covered with three or more coats of hot pitch or asphalt, the latter applied cold if the emulsified product is used. A coarse gravel or crushed stone base under the concrete floor, and a 12-inch layer of such material placed against the foundation wall during backfilling helps to minimize condensation on interior surfaces and leakage of storm water and ground water into the basement. Further protection by use of drain tile laid along foundation walls at the footing level should not be overlooked.

In addition to such provisions, the basement itself should have adequate damp-proofing. There are three methods in general use for this: (1) membrane damp-proofing, with layers of felt bonded and sealed with tar pitch, or layers of mastic, incorporated in the floor and walls; (2) integral damp-proofing, with compounds added to the concrete when it is mixed; and (3) surface damp-proofing of the basement walls. Best results seem to come from a combination of the first and third methods, or of all three in special cases. If a building has an open light area excavated to basement floor level on one or more sides, some of the basement walls will most likely require damp-proofing, if only against the weather. However, such an area may itself have to be constructed with an impervious floor, drained by being laid to a fall, and with damp-proofed outside walls.

It must be emphasized that the basement of a museum is not a cellar, but a busy lower floor.

REINFORCED CONCRETE FRAME, or a fireproofed steel skeleton, is now the rule for buildings of any considerable size. There are several museums of monolithic concrete—notably the Colorado Springs Fine Arts Center—in which frame, floors, and walls are integrated in a single continuous structure; but this is exceptional.

Under the influence of modern design, bulky elements of construction, whether in masonry or concrete, have largely given place to lighter parts. There is still some use of substantial piers, especially at portals. "Many people who are responsive to architecture prefer to see a massive bearing material frankly treated as such, whether it be stone, brick, adobe, or concrete block," says the Museum of Modern Art in its *Built in U. S. A.* (1944). However, the modern aesthetic as well as functional and structural developments make for increasing lightness of effect.

Where parts of the frame support balconies or other accessory structures inside the building, it may be desirable to have the supporting structure independent of the main structure as a possible assistance in remodeling at some later time.

EXTERIOR WALLS are no longer put up as protection against street mobs, and they do not need to be designed as masonry fortifications. Panel walls closing the spaces between frame members and supported on spandrel beams or foundation wall are commonly employed.

Exterior walls must be adequate as defenses against the weather, however. For this the usual construction is in two main layers—an outer impervious skin of brickwork and exterior facing material, and an inner pervious layer of hollow terra-cotta tile and interior finish—the two layers separated by a damp-proof layer and sometimes by an air space as well.

Damp-proofing, usually a coating of pitch or mastic applied to the inside surface of the masonry and continuing across inside surfaces of the reinforced concrete frame, is essential as a rear defense against the elements. The forward defense is the masonry wall itself, which should be laid with every care. Joints in the outer wall, as at setbacks and over windows and doors, may require metal flashing, pitch impregnated membrane, or other special protection. Overhangs, resting on cantilevered extensions of floor, may pose similar problems; and in addition they require special gutters to carry off water that would otherwise drip, perhaps most inconveniently, from the structure. Damp-proofing of exhibition walls is discussed in another place (page 151).

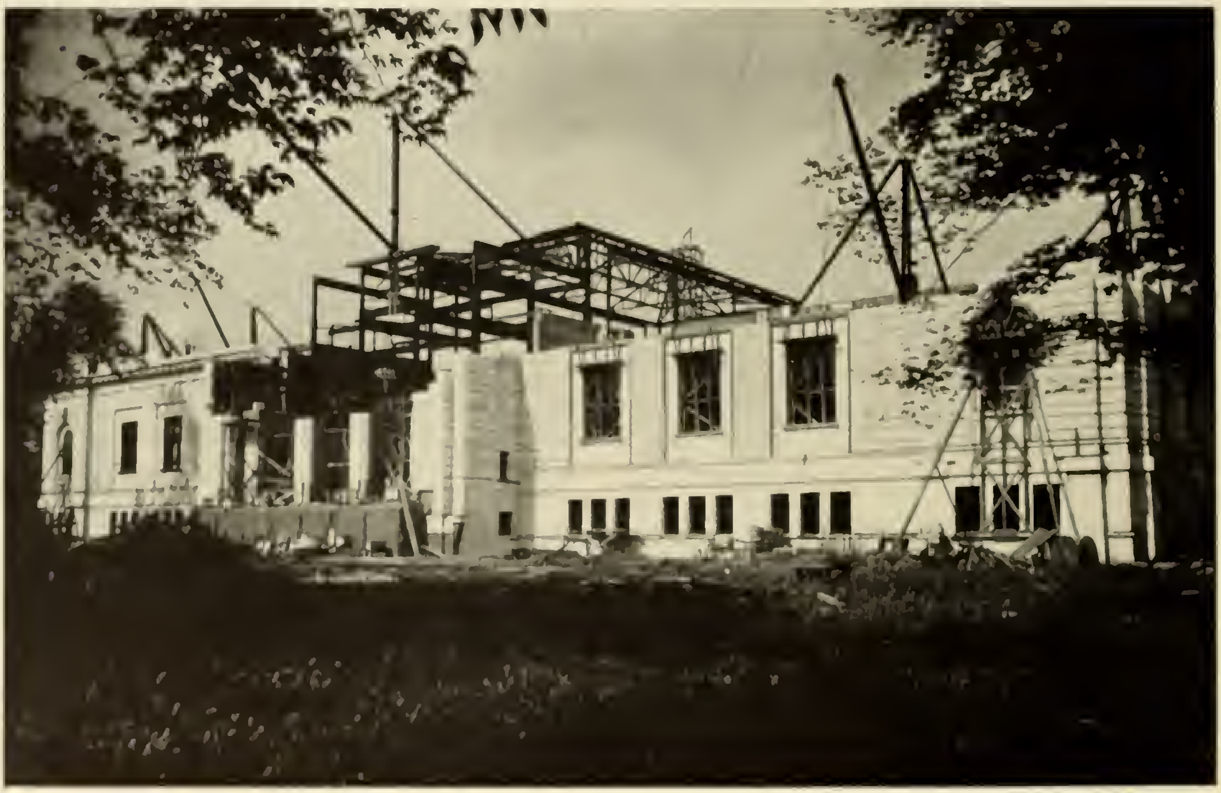
Heat insulation in walls, provided primarily by the several layers built as described above, is greatly increased by the presence of an air space between the outer and inner layers. Cork or other insulating materials used to be employed extensively, but a cavity wall with its air jacket is now common construction. Outside walls must be designed against any possibility of heat transmission such as would bring about condensation behind display cases or pictures placed against inner walls; and they must also do their part in maintaining desired temperature conditions, and in thus easing the load on the air conditioning plant. However, heat leakage—inward or outward according to season—may not be through walls as much as through the roof and light openings, which must also be sufficiently tight fitting and insulated.

Facing of walls is in stone as a rule, although brickwork facing with stone trim is common and some other materials are in use.

The stone used most often has been buff Indiana limestone—either selected stone, for uniformity or to give a color gradation from top to bottom, or the cheaper run-of-the-mine stone which some people like because of its mottling. Indiana, by the way, produces more than 80 percent of the country's building limestone, mostly from the region of Bedford and Bloomington. Other limestones noted in museum use include those of Texas and Wisconsin; also Minnesota dolomites, known as Mankato and Kasota stones, have appeared in several recent buildings, as at Philadelphia and Cranbrook. There is a growing tendency to use local stones for exteriors, although travertine and other imported limestones are commonly adopted for lobbies and corridors. Marbles of Georgia, Vermont, Tennessee, and some other states have had considerable use. Other stones appear only here and there: sandstone, as at Newark and Seattle, and (Idaho sandstone) at Boise, Idaho; granite, as in Washington's Freer Gallery and (Connecticut granite) in New London's Allyn Museum—although granite is used principally for steps, terraces, and trim. Flagstaff has taken local field stone for its building, out of town. Elsewhere, local ledge stone has been used.

Brick is a less ostentatious material than stone, always popular for public libraries (about four to one according to ALA data) and increasingly employed by museums. For small buildings brick is especially appropriate, but there are also brick buildings of larger size: Harvard's Fogg Museum, Yale's

DETROIT INSTITUTE OF ARTS UNDER CONSTRUCTION, SHOWING STEEL FRAME AND MARBLE FACING. PAUL P. CRET AND ZANTZINGER, BORIE AND MEDARY, ARCHITECTS

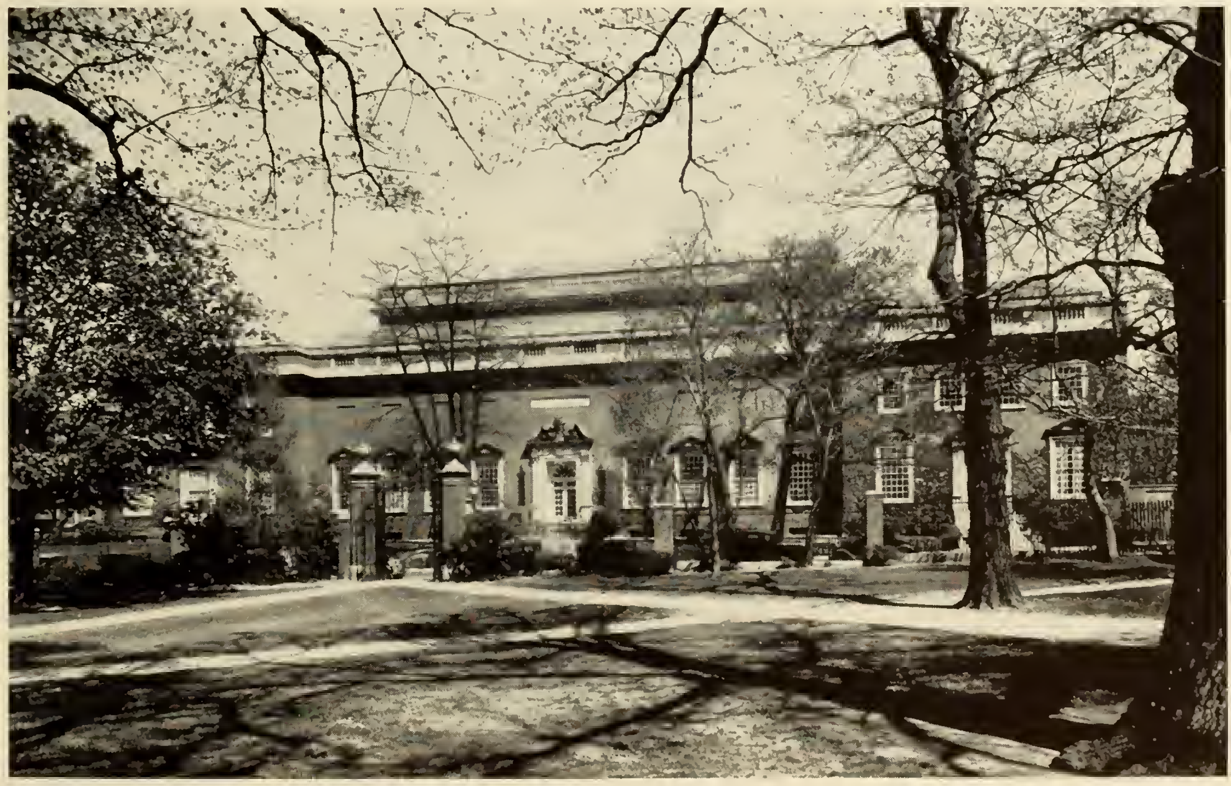


Peabody Museum, the Rhode Island School of Design's Museum, the Portland Art Museum, and the Nebraska State Museum among them. With limestone trim, brick has a very pleasing appearance partly because of its simplicity. There are molded bricks for decorative purposes; and the bond in which any brick is laid can be chosen for pattern.

Concrete stucco over hollow tile walls of small buildings, or as the facing of panel walls in the usual structural frame construction, has had considerable use. For buildings in local versions of Spanish Colonial styles this material is predominant, and in the South and the Southwest it is in keeping with the regional architecture. But for other parts of the country the use of stucco for museum purposes is rare.

New materials for exterior construction have been explored in modern style, but the principal change that has come about so far is a greater use of glass. Many new materials of ready adaptability for interiors cannot be exposed to weather, and some of the new materials that have found a place in buildings of other kinds do not lend themselves very well to museums. Further, it should be remembered that the established materials are not threatened by modernism, if only because some of them are new enough to have helped in producing contemporary style itself. "No substitutes are available in permanent construction for concrete, steel, brick, stone, lumber, glass, wire, certain metals, etc.," says the firm of Eggers and Higgins, New York, in a recent brochure.

FOGG MUSEUM OF ART, HARVARD UNIVERSITY, WITH BRICK FACING OF EXTERIOR, AND LIMESTONE TRIM. COOLIDGE, SHEPLEY, BULFINCH AND ABBOTT, ARCHITECTS



New molded and ceramic materials, metals in new uses, and especially plastics should be viewed with interest, and judged by their performance.

Glass, which is a new material only with respect to the manner and the extent of its use, has been employed to advantage in museums as in modern structures of other kinds. Moreover, museums have employed structural glass in its natural and proper role—as a material admitting light, not as a novel substitute for other facing materials over opaque panel walls. Among public museums, the Museum of Modern Art, New York, shows the largest proportion of glass exterior wall surface; while a number of other recent buildings have made lesser, but still notable, uses of structural glass—witness, Dallas, Grand Rapids, Wilmington, and Colorado Springs. As early as 1930, an industrial museum in part of the Worcester Pressed Steel Company's modern building adopted steel and glass panel walls in reinforced concrete frame. The long-standing use of glass in art museum *roofs* is of course a totally different matter.

Glass, if used extensively in exterior walls, must be of some type that does not impose excessive air conditioning loads and that does not put proper conditions of humidity out of reach by introducing places where condensation will surely occur in times of cold. For ordinary windows, double glazing is effective (page 91); but for large panels, insulating glass or glass blocks may be required. Low-conduction glass, such as that installed at the Museum of Modern Art, is held in a grid of extruded metal glazing bars. In the façade, on two exhibition floors, the mullions of this grid are supported by structural steel angles from the edge of the reinforced concrete floor. In the rear of the building the ground floor has plate glass panel walls, the floor above has glass block panels, and three floors above have ribbon windows. With any such construction, be it noted, a building is necessarily a working mechanism of which the air conditioning plant is an essential part.

Glass blocks enclose air pockets, and when laid in a panel they are roughly equivalent to an 8-inch masonry wall with regard to their heat transmission. Sound transmission by glass block is also low. For different light requirements there are different types of glass blocks—diffusing types to break up light, prismatic types to throw the light toward the ceiling or elsewhere as desired, and transparent types to give window panels either entire or as spots in larger diffusing panels. Glass blocks are usually employed in areas of not more than 100 square feet. Very long horizontal courses are practicable if the height is not over a few feet. Long vertical strips have to be narrow also, and in addition they must be held with stiffeners and wall ties. Expansion and contraction with changes of temperature can be taken care of with expansion strips and special cement.

Tile, *terra cotta*, *cast stone*, and other ceramics and cement products are in some use, partly decorative, for both interiors and exteriors of recent museum buildings. The growing interest in color for façades has pointed to tile for this purpose also. At Wichita the facing of Stein's art museum is in cast stone "used as cast stone," with appropriate molded shapes and ornaments. This treatment overcomes the entirely right objection to cast stone made to look like cut stone and used as a substitute. Interior use of tile has been mentioned elsewhere (page 156).

Metal trim—whether as metal doors, grilles, railings, door and window frames, or in some other form—appears in practically every building. The accustomed metal is bronze, which weathers well and on the whole is satisfactory. Cast bronze ornamental work is very appropriate for public buildings, and extruded bronze is available for moldings and frames. However, recent years have shown more and more use of other metals. Aluminum trim is good in appearance with modern design, as at Colorado Springs and Des Moines; but aluminum scratches easily, and may warp from exposure to the elements. Stainless steel is now used extensively for exterior parts such as mullions, spandrels, moldings, window and door frames, and marquees; this material is available in bright, polished, and dull finishes.

PARTITION WALLS should be non-load-bearing, as far as is possible, to make for flexibility of arrangements. Divisions that seem most likely to be permanent are sometimes made with hollow tiles of clay, gypsum, or concrete, and the required interior finish. Less permanent partitions are increasingly of light fabricated material; and in some kinds of exhibits the divisions are made with the exhibition cases themselves—a method of long standing that has gained in use and in freedom with the growing adoption of special cases furred from floor to ceiling.

Glass block partitions appear in several museum libraries and some workrooms, as aids to lighting. In the Museum of Modern Art and in several campus museums, as at Vassar, glass block partitions in work space and elsewhere seem to be very satisfactory.

Folding partitions are employed somewhat to divide spaces temporarily at will. This is seen especially in the educational part of the building, where classrooms and meeting rooms of adjustable size are useful.

FLOORS, in fireproof construction, are of reinforced concrete. Floor slabs may be supported on four sides by the framing of rectangular floor areas, or they may be continuous across rectangles of supporting beams and girders. In Hartford's Avery Memorial, balcony floors around a central court are cantilevered, giving a wide central span of frame without intermediate supporting columns. This provides a large uninterrupted space for the auditorium in the basement.

Three categories of floors—the basement floor; the first, or main, floor; and upper floors—offer somewhat different problems. The basement, or sub-basement, floor is unique in having problems of damp-proofing, as noted. The main floor, near ground level, is likely to be the principal load-bearing floor since the heaviest exhibits, if not all the exhibits, and the largest crowds of visitors impose their loads here. Upper floors have lighter burdens as a rule.

Floor loads—that is, the live loads for which the floors of any building must be designed—are specified by building codes in minimum pounds to the square foot. These usually run from 70 pounds for office buildings to 250 pounds or more for heavy-storage warehouses, with intermediate requirements for other public and business buildings according to the nature of occupancy. In museums the minimum requirements of the code should not be the sole guide, since live loads vary with changes in use of the building. Probable loads should be calculated as accurately as possible, and provisions can then be made for any predictable excess loads at particular points. Thus, for example, in a museum of industry planning installations of heavy machinery, perhaps with movable parts, it may be found necessary to provide at some points for loads of 500 pounds, or perhaps considerably more, to the square foot; whereas in many a museum the weight of expected visitors may be the principal live load on which to figure. Floor, and perhaps roof, design should not overlook the possibility of suspended loads of exhibits. In general, a minimum of 150 pounds to the square foot is a good figure to keep in mind. This is intermediate in a series of reported figures from 100 to 250 pounds for exhibition space, and it is above most building code requirements for other types of public buildings. In bookstacks or storages, 175 pounds may be a better guide; 30 pounds to the *cubic* foot can be taken for rule-of-thumb determination of the weight of bookstacks alone. For offices and similar spaces, 70 pounds to the square foot is ordinarily sufficient. Consideration should be given to designing corridor and passage floors for momentary extra loading whenever some heavy object is moved through the building to a place necessarily ready to take excessive weight.

Floors of reinforced concrete construction are now usually laid with the concrete as a monolithic fill, poured either on removable steel or wood floor forms, or on precast concrete slabs or hollow tile blocks that remain in the finished floor slab. However, some recent museums and plans for a number of projects have adopted cellular floor construction of a type known to the industry as Robertson "Q-Floors."

Cellular floors are made by spanning the spaces between beams (spans up to 25 feet) with a series of patented rolled-steel units that give a permanent corrugated sheet steel surface over which the concrete floor-fill is poured. This makes a strong and comparatively light floor in which the corrugations, laid right across intermediate beams, form a system of parallel raceways for electrical wiring and pipes. Columns and girders of the frame, if they are of steel, are encased in concrete, or fireproof block or brick; but the special steel under-surface and any intermediate steel beams on which they rest are protected from below by a suspended fireproof ceiling. The suspended ceiling may be of vermiculite plaster with a micaceous base, which has high fire-resistant ratings. Floors of this kind are fully equal to live loads such as museum uses impose. Their channeling is very useful for lighting connections and outlets at any point on the finished floor, and for connections to fixtures attached to the ceiling below.

It is not in order here to go into standard methods of reinforcing concrete, but it may be remarked that floors of some recent buildings, including some very costly buildings, have not been properly constructed for strength and rigidity. The commonest difficulty is having cracks develop in the surface over beams—which can be minimized by laying reinforcing bars in the floor slab near the upper surface over beams and near the lower surface between beams. The latter reinforcing is usual, but the former is sometimes overlooked. Not uncommonly a beam is limited by architectural or other conditions to a size insufficient for the proper resistance to bending. Extra reinforcement, correctly placed, can overcome this.

Floors, especially of exhibition spaces, should be true. Changes of installation, which may require relocating partitions, are greatly assisted by true floors and ceilings. Further, installations that rest on the floor for long are likely to reveal by their slow displacement any deviations of the floor from the horizontal plane. Cases and bases will shift on uneven floors, and objects in an untrue case will march along shelves and decks.

Floor coverings have been discussed, in general and with reference to different kinds of rooms, in the chapter on exhibition space (page 154).

THE ROOF, as designed for most recent museums, is flat. In many an older museum the roof is pitched, and may have old-fashioned skylights set in its slanting faces; but modern museums that have skylights at all have them built lantern-fashion on a flat roof, with a surrounding catwalk and a screening parapet. Many little museum buildings, new as well as old, including those in the early American domestic styles with gabled roofs, are outside the range of these observations.

Roof construction, unless for some exceptional purpose, anticipates live loading of not more than 50 pounds to the square foot. But there may be roof uses to set special requirements. Thus, at Rochester's museum there was talk of a helicopter landing platform on the roof. There have been other plans, which seem very sensible, for using roof terraces as outdoor reading places, lounges, or promenades in good weather. The Museum of Modern Art has a roof balcony as part of its members' room and restaurant space. Also, a bulkhead or penthouse for part of the air-conditioning plant may affect roof design.

Roofs are commonly of precast concrete slabs or patented roof slabs, set between intermediate beams and overlaid with several thicknesses of an impermeable membrane, topped with a concrete fill and tiles or gravel in pitch. Metal roofing has been used also.

Drainage and weather-proofing are important. The roof surface should be laid to a fall for discharge of rain. There is an exceptional arrangement at the Rochester Museum where the roof can carry a sheet of water up to six inches deep on its roof to absorb the heat of the sun. Proper gutters, flashings, and water-tight construction are prime considerations. Some museums (an early example at Cleveland) can melt snow from the roof by a special system of steam pipes.

Skylights and their construction are discussed elsewhere (page 96).

INTERIORS, in terms of wall and ceiling finishes and flooring have been discussed in other chapters. Exhibition room walls and ceilings may not need to be finished until their exact uses have been determined; and, even then, walls that are to have period paneling, or furred-in cases, or other concealing installations need not be finished.

The walls of lobbies and public corridors are sometimes finished in stone. Granite and sandstone are too severe for this purpose, but marbles and limestones are in common use, and travertine is much employed because of its warmth of color and pleasing texture. Some buildings carry their Indiana limestone exterior facing through the vestibule to the lobby and perhaps also to the stairs and corridors. However, efforts to create architectural displays of special or contrasting stones are very ill-advised; and, it should be needless to add, schemes for representing all the natural resources of say a county or a state in the trim of a county or state museum are unspeakably bad. The architectural treatment of all museum interiors should be simple and restrained. Acceptance of this principle for exhibition space, which is now fairly well assured, does not leave the designer free to put on in any other space a permanent exhibit of ornament.

Ceilings of rooms are now, for the most part, suspended (hung) ceilings (page 137). The flat, beamless surface so produced may be an aid in lighting, acoustical treatment, and space design, for either public rooms or workrooms. In fact, one of the most effective devices of modern lighting treats the ceiling as a plane, adjustable for height and lighting pattern, made up of interchangeable flush luminaires and opaque ceiling panels. Together with cellular floors such an arrangement gives the greatest possible freedom.

Architectural acoustics, or the applied science of putting down noise and promoting sounds that are wanted, is an important subject touching museum interiors. Street sounds can be shut out by well known devices of construction, some of which serve other purposes also. For example, double glazing and tight framing of windows help to control sound, dust, and heat. Reinforced concrete construction itself can be sound-proofed in foundations, columns, girders, walls, floors and roof against rumble such as city transportation and building activities may set up. Sounds from the museum's own machinery can be stopped by lead cushions or resilient fibre, cork, or rubber mountings under motors of pumps, fans, elevators, and other moving equipment; and there may be need for measures to keep sound from traveling along air conditioning ducts (page 213). Further, to avoid the click of women's heels on corridor floors, one of the softer floorings may be employed; and for wood floorings, much used in exhibition rooms, the wood may be set in mastic rather than attached to sleepers. But apart from all such matters of preventing nuisances, there are two kinds of acoustical problems for the museum architect—first, to assure the spiriting away of the sound of voices and rustle in exhibition rooms, of chatter in classrooms, and of work noises in offices and other workrooms; and, second, to provide for the successful delivery of sounds that are made to be heard, notably speech in meeting rooms and music in auditoriums and garden courts.

Sound-quieting by absorption is accomplished through acoustical treatment of ceilings and walls. Hard surfaces such as those of hard plaster, tile, and glass ordinarily absorb less than five percent of the sound that hits them; they reflect the rest of the sound, perhaps again and again. Only in a very large room is there likely to be a true echo in consequence, but in every room sounds are more or less prolonged and multiplied as reverberation. To hold this effect within limits, acoustical materials are used for interior surfacing. On the market there are acoustical plasters made for application with trowel or spray gun, blankets of mineral wool or hair felt designed to be covered with cloth, perforated metal plates, and structural and veneering boards and tiles of compressed granular or fibrous materials with various textures and types of perforation. These materials—the last, or boards and tiles, being most in use—swallow a large part of all sound reaching them. Their absorption coefficients (or the proportions they do away with) run from 40 or 50 percent to nearly 100 percent, as compared with from one to four percent for ordinary hard plaster, six to eight percent for wood paneling, and about 20 to 30 percent for carpeting. The area of acoustical material needed to quiet a room satisfactorily depends on both the room and the acoustical material employed. The place of application is most often the ceiling, sometimes the walls, sometimes part of the ceiling and one or more walls. Manufacturers can supply information leaflets about their lines of material; the Celotex Corporation, Chicago, has published a very useful book: *Less Noise—Better Hearing* by Hale J. Sabine. There are many good general texts including: *Acoustics of Building* by F. R. Watson (1930, John Wiley and Sons), the more technical *Acoustics and Architecture* by P. E. Sabine (1932, McGraw Hill), and the recent little *Applied Architectural Acoustics* by Michael Rettinger (1947, Chemical Publishing Company).

The problem of making an auditorium acoustically effective consists both of getting reverberation within limits by absorption of sound, and of building up the speaker's voice or other wanted sound to proper audibility by electronic amplification. Music calls for somewhat different means than speech, so that music rooms require special study.

STAIRWAYS, present in some form in practically every building, should be arranged with grouped flights of steps; they should not be divided into scattered parts, as where there are two or three steps from the vestibule to the lobby, a few more from the lobby to adjacent exhibition rooms, and perhaps others to slightly higher levels in other rooms. The purpose of stairs is to connect floors, not to get around architectural difficulties with elevation at the cost of creating serious museum problems. Scattered steps block the paths of handicapped people, who could otherwise go easily to an elevator—even the freight elevator if there were no other. Also, scattered steps may interfere with moving cases and other heavy objects from place to place. One great museum has an improvised portable wooden bridge to span a corner of its lobby when heavy objects pass between two adjacent exhibition spaces.

The main stairway should connect with the lobby, and should be placed for both convenience and space economy. It is a mistake to locate stairs directly in an exhibition room; to do so increases the fire hazard and interferes with the appearance and usefulness of surrounding space. Even stairs in a corner of an exhibition room are out of place, although an exception would have to be made for the main stairs of a small museum in what is really lobby space forming part of an exhibition space, as at the Cranbrook Academy of Art. Planners should not be led by promptings of bilateral symmetry into providing two stairways if only one is called for. Multiple public stairways may be required by building laws, and perhaps also for the convenience of visitors. In some cases the law can be met by having a staff stairway within reach of the public in an emergency. Guidance in planning stairs may be found in the *Building Code* of the National Board of Fire Underwriters, New York.

Stairs should be in straight runs, and also in fairly short runs with ample landings at floor levels and between them. Circular stairways, angled stairways with winders, and all other kinds of stairways with steps that do not have parallel edges all the way between landings, should be strictly banned. A flight with wide ornamental steps at the bottom is likely to have the effect in some degree of a curving stairway. People have performed miraculous falls by taking such steps from the side. Where funneling effect is wanted at the approach to an ascending stairway, straight steps may lead from two or three directions to a slightly elevated rectangular platform from which in turn a straight flight springs.

For fullest fire protection, each stairway would be arranged with doors that could be closed quickly or that would remain closed at rest. This is hardly feasible for the principal stairway, but secondary stairways can often be so planned. Sometimes a stairway is designed for public use between the first and second floors, and for staff use above and below. With this arrangement doors may be omitted at public levels; but doors, perhaps with hidden spring locks, may block the way to other floors. However, separate stairs for the staff may be better, and these are often in narrow runs between partitions. Care should be exercised to see that stairways do not provide unguarded paths of egress from the building.

Flights of stairs should be arranged in a simple way that offers no unnecessary circulation problems. Double stairways with exits at alternate floors, and discontinuous stairways in which the visitor has an even chance of finding the wrong flight first, are not recommended. Stairs commonly occupy shafts or stair towers between suites of exhibition rooms. A secondary stairway so arranged is sometimes in a shaft that is offset from the back or side of a building. Such a shaft may contain both stairs and an elevator—perhaps staff stairs and a staff or freight elevator.

The staircase must not provide a well for little boys to fall into. Half flights should hug to the median plane so that anyone falling over the rail of one flight would land on the next flight below, rather than in the basement. Flights that circle an elevator shaft or embrace closets are not advantageous.

Public staircases are finished in keeping with the lobby and corridors. If stone is required for steps, it should be of a kind on which wet shoes do not slip. Otherwise terrazzo steps with friction treads may be adopted.

There should be a grasp rail at each side of every flight of steps throughout the length of the flight. A middle rail is a nuisance. This can be avoided by having steps which, though useable in both directions at once, are not wide enough to let old folks get stranded in the middle. Hand rails should not encourage sliding. Metal lugs set in rails at intervals will prevent this quite effectively.

All stairways should have adequate artificial lighting. This means general illumination of the passage, and sometimes step lights as well. One isolated step or a run of two or three steps between landings ordinarily requires step lights to give warning. Natural lighting of stairways by day, regardless of other means, may be desirable. Some stairways have continuous panels of glass blocks or other glass rising from landing to landing.

ELEVATORS, passenger and freight, have been discussed (pages 123, 192). Automatic operation by push button is desirable in all cases, but this does not preclude having attendants for public elevators if, or when, necessary. Elevator doors should open automatically. A good type of door for the freight elevator is one that divides horizontally in the middle and opens upward and downward.

RAMPS AND ESCALATORS may replace stairways and elevators in some future buildings. This has not happened as yet; but several projects of the moment contemplate ramps, and others have escalators. One of the former is the Wright design for the Guggenheim Museum, New York, already noted. This will give a building in which the exhibition space itself is to be a long spiral ramp—in addition to which there will be "fast ramps" ascending from level to level by close turns enclosed in a shaft. This will be wholly new for museums, although straight and widely curving ramps have been used in exposition buildings. A ramp that follows two sides of the principal exhibition space will take the place of main stairs in the coming Indiana State Museum at Indianapolis. Escalators are proposed for the new buildings of the Illinois State Museum at Springfield and the Milwaukee Public Museum, connecting all exhibition floors.

Ramps and escalators have points for and against them. Both take up considerable space; the proposed Springfield escalators take up nearly the whole front of the building. Ramps are inexpensive in construction and operation, whereas escalators are costly to install and to run. For the present at least there is novelty in favor of both devices. Where enormous crowds must be moved something of the sort might even be a necessity. Ramps are silent. Escalators make noise, and they may perhaps be most appropriate in museums having live mechanical displays that set up their own commotion.

PLUMBING should give occasion for an early review of plans by the building committee, checking room by room for details. Drinking fountains will be required for the public, and others may be wanted for the staff. Mop sinks in janitor's closets should not be overlooked. Wash rooms, shops, offices, kitchen, and other work places should be studied with great care to discover in advance the requirements of all appliances that will be installed. If there is a standpipe system, necessary roughing should be provided, and clearance should be allowed for pipe connections to all points where water will be needed in the building and to outside hose connections. Workable parts should be within easy reach for operation and repairs, but not where the public can readily tamper with them. There should be stop valves for boilers, showers, lavatories, toilets, and other outlets from the water supply system. The boiler should have a drain to empty it for cleaning, and sink drains in shops should have sediment traps to catch solid matter.

Hot water requirements for building maintenance, shop work, showers, and other purposes should be anticipated. In a small building a gas heater of storage type may be sufficient, but in large buildings an indirect system employing steam is usual.

Basement drainage to the sewer may require special attention. Some sites create need for a sump pump, and may call besides for standby electrical equipment to be used if current fails. Outside areas subject to flooding in storms should be adequately drained to lower levels. Low-level plumbing may require a sewage ejector.

ELECTRICAL INSTALLATIONS, including the system for control and distribution of purchased electric current as well as appliances operated by electricity, are required in practically every part of the building.

The dozens or scores—or, in a great building, many hundreds—of electrical appliances that a museum needs can be discovered only through study of the plans, space by space, always with reference to contemplated uses. The electrical blueprints offer one of the important chances for keeping down cost by exercising foresight. Lighting installations will be called for throughout. Exhibition areas have their special requirements, as Chapter VII indicates. Some of the needs of exhibits may develop only with the exhibits themselves, but the necessary outlets can be provided in advance. Air conditioning calls for motors and other electrically operated devices in the central plant and elsewhere. Workrooms make exacting demands, as for motor drives of machines in shops, special lights and other equipment in photographic rooms, cooking and dish-washing appliances in the kitchen, and so on according to the size and complexity of the building. The auditorium should have special lighting controls, projection apparatus with accessory equipment and signals, and a public address system; and each classroom needs some provision for dimming and projection. If there is an organ there will be electrical accessories for wind and action, if not for electronic sound production also.

The main electrical switchboard, in the superintendent's quarters, should be planned with a view to growing calls upon it. There should be an allowance of fuse blocks for added circuits. Power cut-offs, if not to be constantly supervised, should be arranged and labeled for emergency operation. Time switches may be installed for economy and safety. In large buildings there may also be scattered load centers, and these should be subject to both local and central control and should themselves provide through extra switching gear for multiplied connections.

The distribution system should also be planned for the future. It should have ample raceway and conduit capacity, perhaps with reserve conduits. Where machines are to be connected there may have to be heavy duty connections and appropriate outlets perhaps with receptacles of lock type. Local light switches, watchman's signals, and the like are required. These are commonly placed on door reveals in exhibition spaces.

For lighting and perhaps operation of exhibits, outlets may in time be required at many unpredictable points. Base plugs are all right for displays against the wall, but are of little use with free-standing exhibits. For the latter purpose even a generous layout of fixed floor receptacles may not meet all requirements, although many a museum has less than this provision. The only fully satisfactory arrangement is an underfloor wiring system that can be tapped at any point. There are on the market several makes of preset ducts designed to give complete freedom. We have noted the cellular type of reinforced concrete floor (page 224) that has parallel raceways for wiring over girders and beams; for floors of this kind, H. H. Robertson Company of Pittsburgh makes patented wiring channel that is laid across raceways for wiring at will to any floor position. Several other concerns, including Walker of Conshohocken, Pennsylvania, produce special steel or fiber channel and related fixtures for accomplishing the same purpose. Such an installation, though adding to initial cost, is likely to be economical in the long run.

Lighting accessories offer many problems by themselves. Exhibition lighting fixtures have been discussed, but a word on maintenance is in order. Artificial lighting falls off fast in its intensity, due to ageing of lamps and to dust. Frequent replacement is indicated, and ease of replacement is desirable.

Illuminated direction markers, some of them practically general exhibition labels in character and effect, are employed in many museums. Unlike transparent labels in cases, which are lighted in conjunction with their exhibits, direction markers are parts of the house lighting system.

Emergency lights, to carry on if regular lighting fails through interruption of public utility service, are important for the safety of both the public and the museum. Stopgap circuits may take in all public spaces; but they are most important at places of possible congestion, such as the lecture hall. They should also provide corridor, stair, and emergency exit lights. One reason, by the way, for having the auditorium capable of being cut off from the exhibits is that emergency dismissal of an audience should be feasible without exposing the whole museum to confusion and to possible thefts for which, in fact, a false alarm might be staged. Emergency lights are fed by storage batteries that can be charged by the regular power supply, through rectifiers if need be. It is possible also to operate emergency lighting directly from a generator run by a gasoline engine.

Watchman's night lighting may be provided by switching emergency lights to the regular power supply; but many museums depend on the watchman's hand flashlamp for lighting of most of the regular round by night. Fixed night lights should be placed where employees can change them, but not where strangers can readily remove them.

If the outside of the building is to be floodlighted by night, conduits should be laid to outlets when the grounds are landscaped.

Vacuum cleaning, electrically operated, should invariably be provided for, either by checking on electrical outlets wherever a portable cleaner might need to be attached or by installing a central vacuum cleaning system with suction pipes to all key points in the building. In either case, outlets for offices, workrooms, and storages, and for all ordinarily closed spaces should be included. Choice between portable and central apparatus depends partly upon the size of the building. For a very small museum even a domestic portable cleaner may suffice, but for a large public building the advantages are strongly on the side of a central installation. Several museums, as at Cleveland and Detroit, have central equipment. This method develops more suction and holds it for much greater volume, takes the collected dust entirely out of the area being cleaned, and has greater vertical reach. The central unit is a motor driven compressor, from which vacuum tubes follow duct spaces in walls to appropriate points. Outlets may be of inconspicuous recess construction; but, whatever their type, they should not be installed on exhibition walls. A lightweight tube suffices for the portable end-connection as a rule.

Telephone installations in museums range from the simplest to some fairly well developed systems that carry heavy service loads. A small museum may have only a one-station line; but most larger museums have switchboard service with independent trunk lines and several toll loops, and ordinarily there are public booth telephones besides (page 125). The switchboard has as its busiest line the one to the lobby traffic-control point, but the switchboard itself is not at the information desk except perhaps in a small museum where the reception attendant has time to serve also as telephone operator. In some large museums the switchboard operators take care also of the watchman's reporting system and the automatic fire and burglar alarm systems, working in a properly protected situation. Every building should have house extensions to the entrances and to inside key points as required. Installing is the telephone company's business, but the building should provide conduits, risers, and raceways of sufficient capacity for the connections needed. The telephone company anywhere is prepared to advise on such matters.

A most useful electrical device is a call system for finding members of the staff. There is the possibility of thus making too much noise in public parts of the building, and even in some workrooms; but the stations can be studied for this and can still save much staff time in any very large building. Loudspeakers, or preferably gongs of pleasing tone, may be used.

Clocks, electrical as a rule, should be provided in the lobby, at the service entrance, and where required in offices, workrooms, meeting rooms, and elsewhere. Electrical clocks that are individually connected to alternating current supply are employed commonly; but in large institutions there are many advantages of having a time system with a master clock and secondary clocks under its control. This may be accomplished independently or by subscribing to the time service of Western Union.

BURGLARY PROTECTION is a matter of locks, alarms, and guarding; but the effectiveness of it depends considerably on the number and location, as well as on the construction, of doors and windows. A museum that has only two entrances and no windows near the ground would be comparatively easy to watch; but even windows of upper floors have their hazards if things can be thrown out. The growth of air conditioning has increasingly simplified this problem since windows that serve as light openings but are never needed for air can be made to stay shut at least until they are opened by authorized persons.

Door locks should be of high quality, and they should be systematized so that all can be opened by the director's master key and that those of individual rooms can be opened by special keys also. With the manufacturer's help a scheme of lock, key, and door numbers should be drawn up so that there can never be an unidentifiable or irreplaceable key. All entrance doorways and door-blocked passageways should have push buttons and bells, if only to keep the staff from attempting forced entry.

Guarding by human watch is important, by day and by night. The guards who keep eyes on the public, including the doorman at the main entrance and the superintendent's man at the service entrance (and men at other points of exit if any there be) are the main watch when the building is open. At all other times there should be one or more watchmen, with an electrical tour system to keep the watch safe and busy. A combined night watch and fire alarm installation, such as the American District Telegraph Company or other services can install, is likely to be well worth what it costs beyond the pay of the watch. Under this plan, a key inserted periodically at one or more signal boxes connects with a central company or police station; any irregularity is investigated at once. If a fire signal is turned in at any time, the central station calls the fire department. This is better than a portable recording clock which records for the morning after what the watchman has done, but gives no immediate warning of lapse or trouble. Some museums, at Rochester for instance, have alarms that sound if a window or door is opened or a glass is broken out of hours—a form of protection that can be applied also to valuable exhibits. Such an alarm may be hard to control, because of the rigid observance of hours it requires and sometimes because of trouble it has in telling honest people from burglars.

An electrical device that several museums have tried for counting visitors—and at least two have abandoned—is the electric eye, which too seems to see all and know nothing.

FIRE PROTECTION begins with fireproof construction, already discussed. In addition it should include all possible control of major fire hazards, including those of the boiler, the incinerator, the shops, and storages for inflammables. Where there is no separate structure for the heating plant, the boiler room should be contained in appropriate special construction and should have fire doors. The paint shop and its stock room, if not all shops and their rooms for supplies and materials that are not under separate roof along with the boiler, should also be contained within special walls and doors. The place where photographic film is stored should have fire-vault construction.

An important part of planning for isolation of hazards, as well as for safety in case of fire, is the placing of stairs in properly constructed shafts (page 227). Main stairs do not lend themselves well to this, but secondary stairs for public and for staff should be enclosed by walls and doors. Hazards of air ducts have been noted also (page 212).

Museum spaces are of two kinds with regard to fire hazards. First, there are spaces in which water damage might be as serious as fire damage itself, namely, exhibition rooms, curatorial workrooms and storages, and the packing and registrar's rooms; and second, there are spaces in which damage of any kind would probably not be too serious, namely, mechanical shops and storages for supplies, lumber, crates, and equipment. In spaces of the latter kind water sprinklers can be used to put a quick end to any fire that starts. However, exhibition, curatorial, and kindred spaces must not have water sprinklers or extinguishers charged with liquid chemicals. They should have carbon dioxide extinguishing apparatus, either installed as an automatic system or as hand-type units together with portable units mounted on wheel trucks. Compressed carbon dioxide is a cheap extinguishing medium, obtainable everywhere and believed to do no damage to museum materials. In a space such as a storage room, where a high concentration of gas can be obtained with the aid of automatic devices that close ventilating ducts and other air outlets, an automatic installation that works like a "gas sprinkler" is good. This includes a warning device that gives time for people to leave.

Spaces that can have automatic water protection are ordinarily parts of the basement; in fact, much of the basement may call for water sprinkler installations. Spaces that must not have unnecessary water hazards are, in general, above the basement. These should be closely watched and should be protected by the indicated emergency means under hand control. The stage section of a theatre should have its full provision of fire alarm and extinguishing apparatus of whatever kind is most suitable. Wherever excelsior, paper, waste, or other highly inflammable stuff is kept, there should be metal-lined bins, on wheels, constructed to meet requirements of fire underwriters.

In addition to all such protection, a water standpipe and hose are advantageous in any building, and these are practically necessary in a building of several stories. Such provisions do away in an emergency with the need for hauling fire hose, and they minimize the time required for drastic action and limit the extent of possible water and fire damage. Hose connections should be put in early during construction of a building since wooden centering, scaffolding, and other inflammables used on a reinforced concrete job sometimes serve as fuel for a bad fire before the building is finished. The location of hose connections and other fire-fighting equipment should be studied with reference to crowding in case of evacuation, since equipment in corridors, stairways, and lobbies likely to become congested might so be isolated and rendered useless. Hose racks may well be installed in recessed cabinets. If conditions of water pressure call for it, there will be a house pump in the basement, and perhaps also a penthouse tank.

Fully as important as means of putting out fire are means of detection and alarm. These may be operated either by fusion of alloy links or by expansion of gas in tubes. Any sprinklers employed should be of a type that records an alarm when any head is open.

Services of a watchman are very important for detecting fire in an early stage. The smell of smoke may give warning long before the heat of conflagration is sufficient to set off automatic devices.

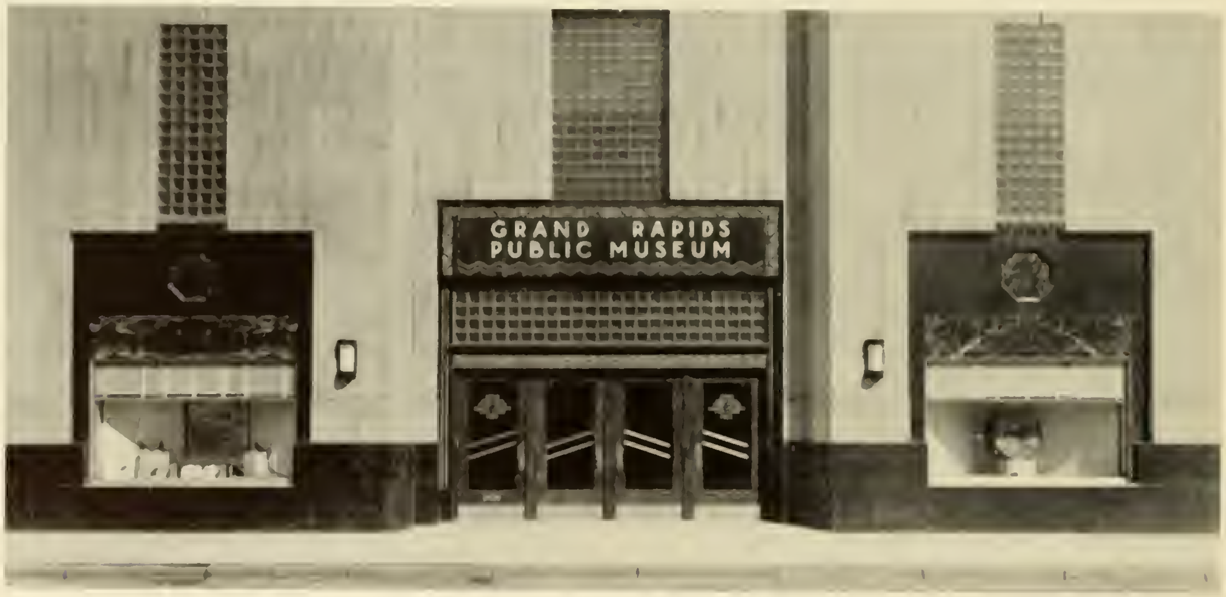
If a museum stands close to other buildings, provision for a fire-protective water curtain may be desirable.

DISPLAY WINDOWS, with their first permanent museum examples at Grand Rapids, are contemplated in several projects—most notably those of the Indiana State Museum and the Denver Art Museum.

The Grand Rapids Public Museum's windows are ten feet wide; the sills of the two on either side of the entrance are 36 inches high from sidewalk level; the windows are seven feet high above the sill, and have Venetian blinds within to reduce the height at will. The cases are deep enough to be entered, and each has its little door from within. The visible depth can be varied by use of screen backs. For comparison with these dimensions the figures given by Wheeler and Githens for windows of libraries are: sill 30 to 35 inches high, case from three to four feet high above the sill and variable by blinds, width of center glass panel (the windows here described are bays to the sidewalk) about four feet. For further comparison one notes that most store-display windows along shopping streets have sills from two to three feet high, and that merchandise is brought to desired heights by use of false decks or bases. The lower sill-level may be better for museums since the sizes of the objects shown may vary greatly. However, the designer might well recall that more and more commercial windows are small and placed high, and that the best museum exhibition zone is between 40 and 70 inches from the floor.

Display windows should be wired for lighting and operation of exhibits. There should be general window lighting and adjustable overhead spotlights. The display case should not be a part of the room behind it, but should be enclosed and have an entrance from the back or side. The space requires heating, but a radiator under the deck is not satisfactory. Condensation may be troublesome in cold weather, and for this reason the cases may require a unit ventilator that can hold relative humidity well below 30 percent. The deck should be of water-resisting material. In science museum windows, water should be on tap.

TWO OF SEVERAL SIDEWALK DISPLAY WINDOWS OF GRAND RAPIDS PUBLIC MUSEUM FLANKING MAIN ENTRANCE AT SIDEWALK LEVEL. ROGER ALLEN, ARCHITECT



EXHIBITION FURNITURE is not within the province of this discussion except as its purchase or design may fall to the architect or may affect the design of the building. Where the architect is thus concerned, as he is in some part of almost every building, he should have the help of the building committee's museum adviser. Too many buildings, going up before even the director is appointed, are equipped by the architect in ways that quite ignore museum experience.

Exhibition cases form the most important class of museum furniture, and yet they are often omitted for lack of funds. Under such conditions, if the architect gives no consideration at all to case requirements, shortsighted arrangements of the interior, that cannot be workable, are likely to be made; hence the architect should study the case problem and at least make favorable arrangements for cases that will come later. A few cases may well be bought to get a sound start with suitable types. In any event, the case problem is simplified by having cases purchased under a separate contract, rather than under the general building contract.

The most important change that has come over exhibition furniture in recent years is the adoption of recessed wall cases of comparatively small size, usually set flush in false walls or furring, to take the place of the older type of wall case that stood free and was moved about. This change throws upon the director and curators much of the responsibility for finishing room interiors when exhibits are installed; but the architect who leaves a room unfinished will probably want to make sketches for the guidance of those who will later design exhibits and construct case housings.

All cases, whether free-standing or recessed, have two main parts—the case proper, and the base or housing. Some museums make the entire construction; but most museums now get metal-frame cases from one of the recognized manufacturers. Sometimes the base is bought with the case proper; sometimes it is made later. With cases of recessed type, calling for housing that is really part of the building, making bases is part of the job of making housings.

Case frames are usually of bronze or aluminum, commonly in satin finish although antique and other electroplated or polished finishes are obtainable. Painted finish on metal is justifiably rare. Though many carpenter-made cases with wood frames are in use, wood is ordinarily not strong enough for this purpose unless the frame is rather too heavy in construction. Frames should be well built, dust and vermin proof, moisture proof, secure against unauthorized access yet easy to open, and good in appearance. Two well known manufacturers of metal-frame cases are: Michaels Art Bronze Company, Covington, Kentucky; and Library Bureau Division of Remington Rand, New York.

Frames may have locks set in them; and the locks may be supported by pressure screws if these are needed for tightness or to avoid multiplication of locks. In each department of a large museum, all locks should be on one key. Also, there should be a master key for all cases in the museum. Each key should be numbered and recorded for identification.

Frameless cases in which cement holds the glass, with or without the aid of metal clips, are obtainable on the market but have not been adopted generally except for small types, or vitrines, that stand on pedestal bases. Cases of this kind are made by Peerless Steel Equipment Company, Philadelphia.

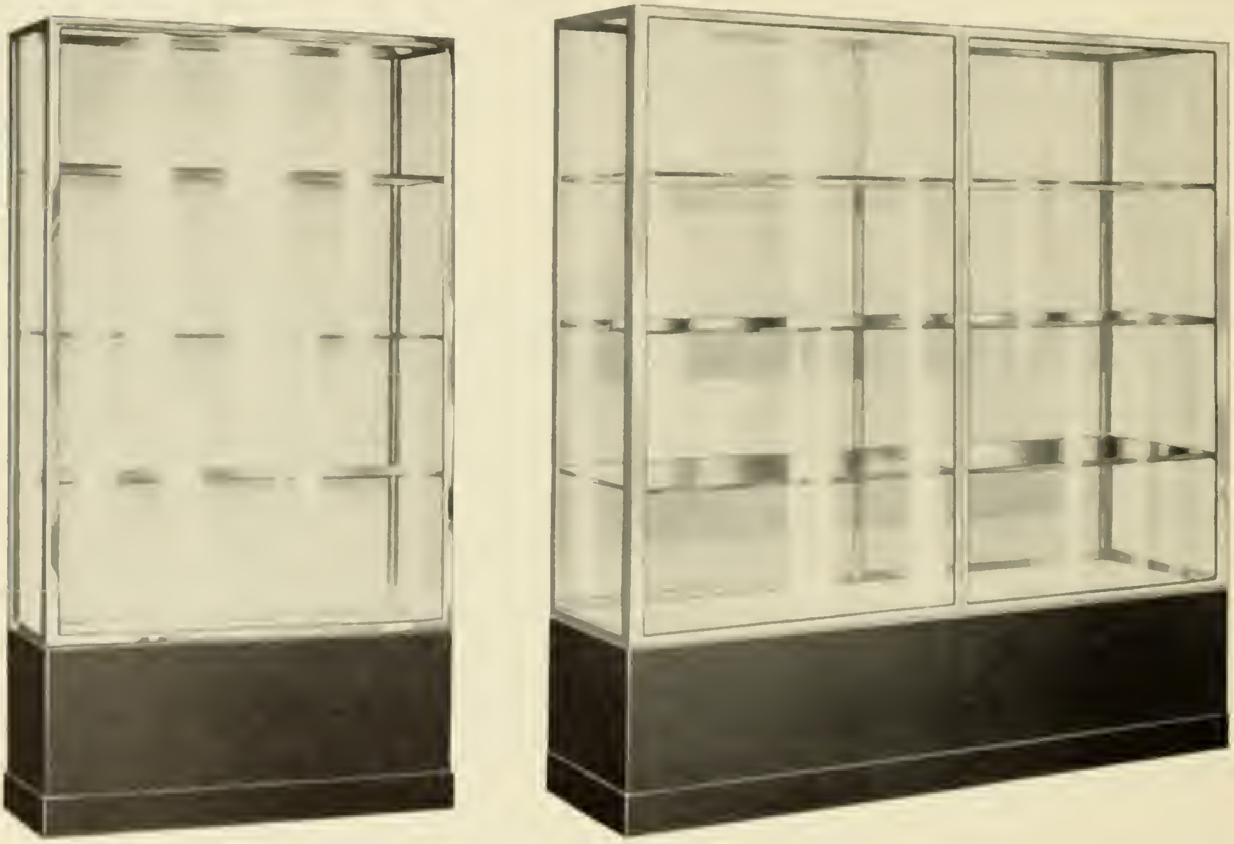
Types and dimensions of cases are of interest to the architect for their relation to room design as well as in their own right. Cases are described as vertical or horizontal according to the position of the glass through which the observer looks. Three types have come into very general use: the wall case—a vertical case, free-standing or built-in, that has its back to the wall; the center case—a vertical case that stands in the open to be viewed from any quarter; and the table case—a horizontal case with a glass top through which objects are looked at from above.

Besides these simple types, several special types are in common use. There is a variant of the built-in wall case which projects instead of being recessed. Two wall cases, made back to back in one construction, form an aisle or alcove case. A table case with its top tilted toward the visitor is a desk case. Two desk cases joined back to back form a low A-case; and there are high A-cases having nearly vertical glass. Also there are combination desk and high A-cases, single or double. These and other special types have their uses, but simple wall, center, and table cases serve most purposes and can make up the first equipment.

There have never been exact standards of size, but practical and aesthetic considerations have combined to establish certain usual dimensions, or ranges of dimension. Thus, the tops of free wall cases are most often at the level of 78 inches from the floor; and the housing of recessed cases, if it stops

WALL CASES WITH EXTRUDED METAL FRAMES, TYPES WITH ONE DOOR AND TWO DOORS. BASES MAY BE PURCHASED WITH CASES OR MADE BY THE MUSEUM IN ITS OWN SHOP

Courtesy Michaels Art Bronze Company, Covington, Ky.



Courtesy Michaels Art Bronze Company, Covington, Ky.

TABLE CASE WITH EXTRUDED METAL FRAME AND WOOD TABLE BASE HAS MANY USES IN MUSEUMS

at a cornice line rather than being extended to the ceiling, is at the 84-inch level as a rule. These heights give space above the frame for any required outside light box without going above the seven-foot level which is the usual "ceiling" for all free-standing cases. The ideal exhibition zone (represented by vertical glass) lies approximately between the 70-inch and the 40-inch levels above the floor. This comes from the fact that the eyes of most grown visitors are a little more than five feet from the floor (usually taken as 60 to 62 inches) and that the eyes should not be more than 18 inches from an object or label for close inspection of it. This defines a favorable zone between the 70-inch and the 50-inch levels, although the lower limit may be dropped to about the 40-inch level if one bends slightly forward. In practice, recessed wall cases tend to have about these ideal vertical dimensions. But there are also larger recessed cases set lower in the wall, and these tend to have about the same exhibition zone as some of the marketed free-standing wall

CENTER CASE ALSO WITH EXTRUDED METAL FRAME AND WOOD TABLE BASE

Courtesy Michaels Art Bronze Company, Covington, Ky.

cases, namely, from a 78-inch top to a base 24 inches high or even less. Center cases are shaped by the same considerations, and they come closer than do most wall cases to the ideal vertical dimensions—rising not much above the 72-inch level from a base-deck above the 30-inch level as a rule. Table cases are shaped by requirements of looking downward into them, and are usually about six inches deep on a table about 30 inches high.

Horizontal dimensions are determined largely by requirements of exhibits and by good proportioning to vertical dimensions. Common dimensions in plan are: for wall cases, 42 or 60 inches wide in one panel or 84 inches wide in two panels by 15 inches from front to back; for center cases, 60 by 34 inches; and for table cases, 60 by 24 inches.

Standard cases on the market are designed for the adult public. It is quite usual to have a step or ledge, from 6 to 12 inches high, for children to mount in front of cases that cannot be seen well from the child's eye-level; but smaller cases are needed for children's museums and rooms of junior departments. Such special equipment has to be made to order.

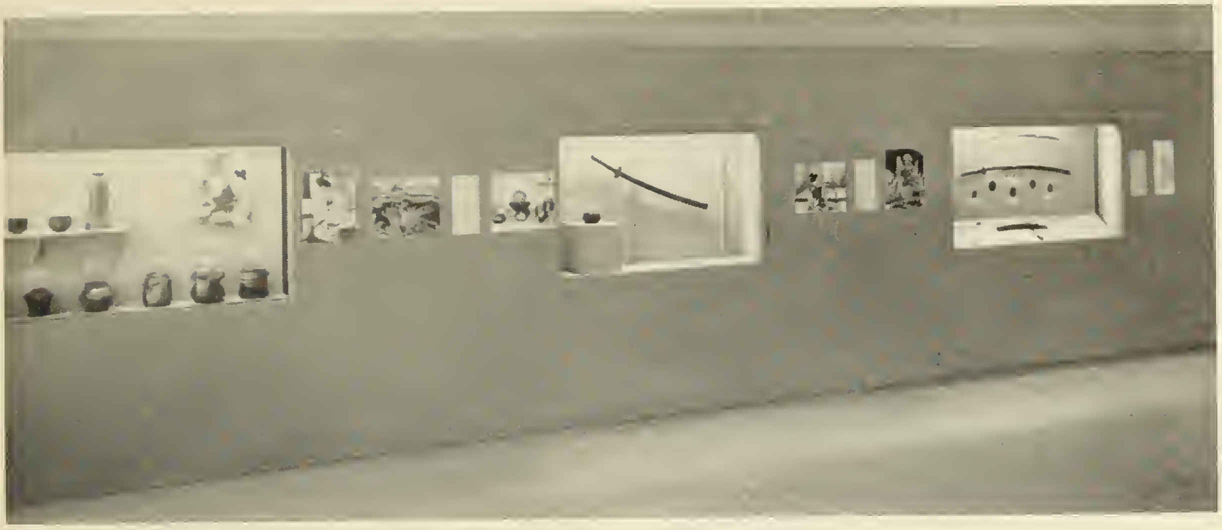
It has been said, doubtless with some truth, that standard equipment is evidence of the curator's incapacity as a designer. However, the realities of museum work, some of which have nothing to do with taste or skill, tend to limit the curator very much in what he can do. The best chances for special designing are offered by recessed wall cases.

Built in, or recessed, wall cases should not form part of the permanent building structure. The usual arrangement is to have a false wall of furring, plastered from floor to ceiling, or from floor to seven-foot level. Behind this accessory wall there is space for recessed cases as well as for required lighting installations above, beside, and even below the cases. Also there is space behind the false wall for any mechanisms needed to operate exhibits and for amplifying or other sound equipment. There is sometimes a service passage behind the housing of recessed cases, to aid in maintenance of lighting and even to provide for opening cases at the rear. The suggestion has been made that recessed cases penetrate more permanent walls, so that case fronts would never need to be opened and that displays could be put in place from workrooms behind. This might be possible on one side of certain rooms in many museums, but the scheme has obvious limitations which do not attach to installations recessed in furred walls.

It may fall to the architect to design wood bases for the different kinds of free-standing, metal-frame cases a museum buys. In this, as in designing temporary walls to take recessed cases, simplicity should be the rule. Cases are not, themselves, displays. Elaborate moldings, ornamental legs, and all ostentatious decorations are out of place. Use of a good wood, though not of a highly ornate wood, is usual for table bases and box bases. The bases of wall and center cases usually have a toestrip, of slate or wood, about four inches high; but a bottom margin painted on the wood of the base itself may sometimes serve the same purpose and can be repainted whenever shoe marks and mop stains have blemished it too much. There is a tendency now to substitute for the toeboard a recess about four inches high and three inches deep.

Using space under exhibition cases for storage of collections is strongly discouraged. Storage drawers and cabinets belong in curatorial storages, where they are part of the special equipment provided for reference collections.

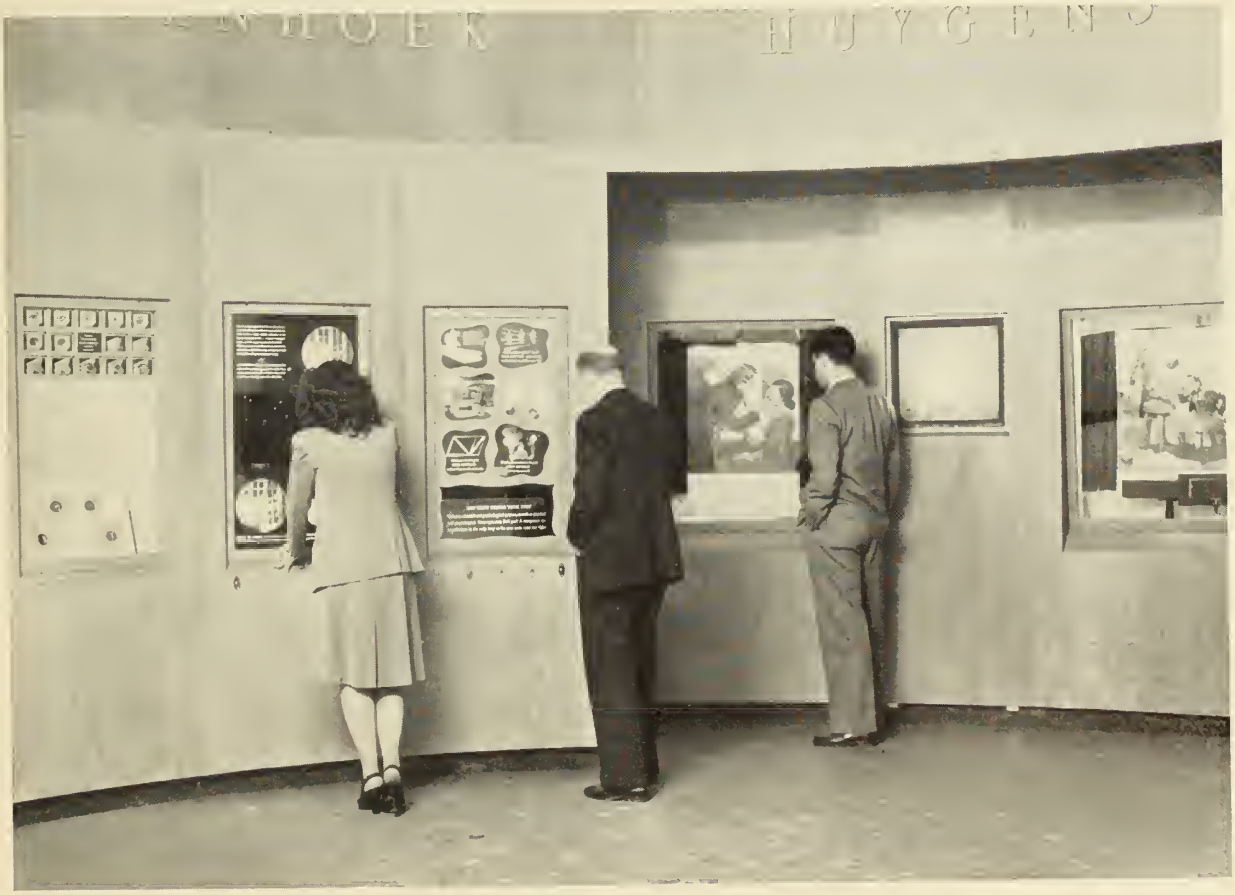
Case interiors are the concern, as a rule, of the curator or the preparator who installs exhibits. If the architect specifies for purchase of cases he should be sure that certain pre-



Courtesy Walker Art Center, Minneapolis

INSET CASES INSTALLED BEHIND FALSE WALL THAT SCREENS CASE LIGHTING EQUIPMENT AND CASE SUPPORTS, IN ART MUSEUM (ABOVE) AND SCIENCE MUSEUM (BELOW)

Courtesy Rochester Museum of Arts and Sciences

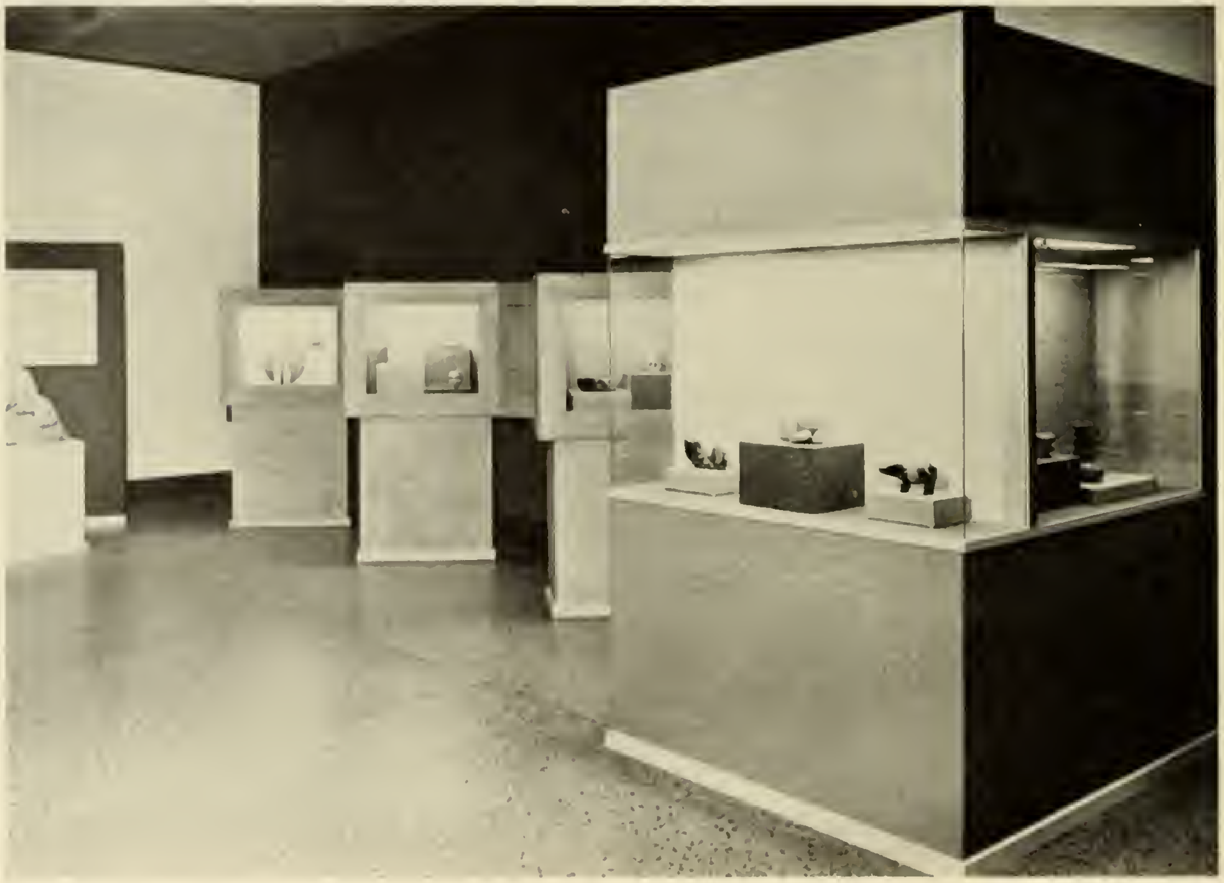


dictable needs are met. These include: in center and table cases—a deck that is itself presentable as a surface on which to set objects, that will take thumbtacks and screws, and that can easily be covered with fabric; in wall cases—a back of the same character; and in all vertical cases—some provision for support of shelves. The usual material for decks and backs is a composition board known as *Vehisote*. Rear or bottom panels of this material are set in their frames in such a way that they can be taken out to have background fabric stretched over them. Mirrors as case backgrounds are not recommended; small mirrors, installed to show the backs of individual objects, are much better. Case shelves are now rarely adopted for installations that can be made without them, but every vertical case should have notching, on the inside of its four vertical frame members, to take adjustable shelf brackets. Vertical cases on the market are so made; and brackets and shelves are obtainable. Other accessories, such as diaphragms, false backs, box bases, and fabrics that may be used with any of them, are usually made or secured by the museum when the exact needs are known.

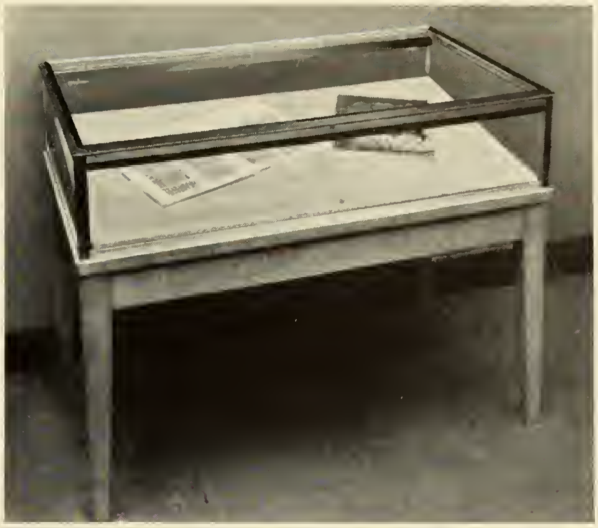
Case lighting is required to make the contents of cases brighter than their surroundings. Early efforts at lighting cases employed

CASES OF SPECIAL TYPES WITH INTERIOR LIGHTING THAT INDICATES ATTENTION TO CONTRAST BETWEEN BRIGHTNESS FROM ROOM LIGHTING AND FROM CASE LIGHTING

Courtesy Walker Art Center, Minneapolis

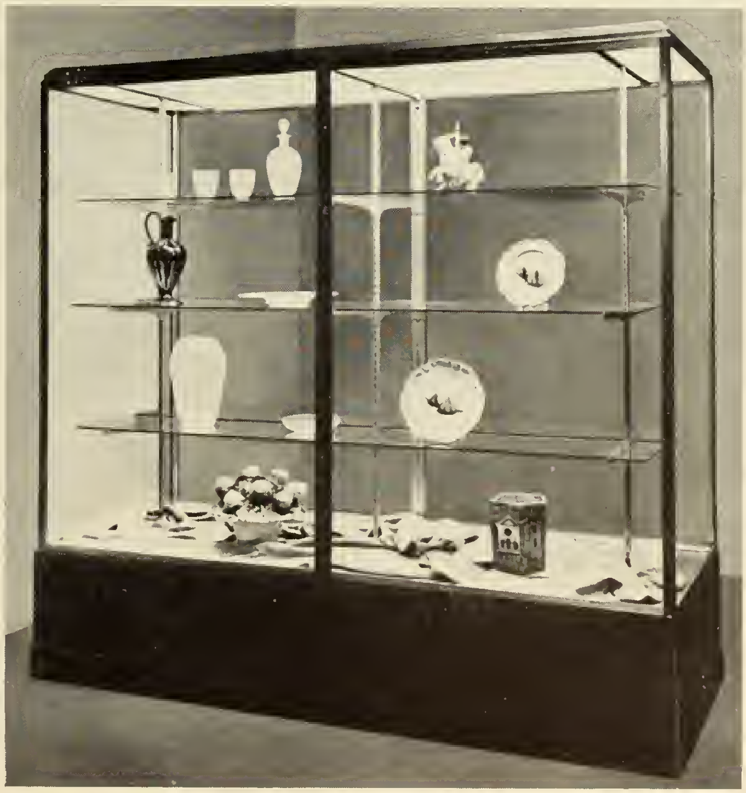


elongate incandescent lamps placed inside the frame; but this method heated the confined air and sometimes damaged exhibits. Later efforts with slender, cold cathode, fluorescent tubes are more successful; and current experiments with filters of patented laminated glass (manufactured by Ivan P. Johnson Co., New York, N. Y.) and with polarizing glass (manufactured by Polalite Corporation, Whitestone, L. I., N. Y.) and also with light-conducting plastics are promising. The problem of case lighting seems at the point of being solved by the industry. Museums should not minimize the importance of getting a good solution. Meanwhile many cases can be lighted tolerably through their glass, from outside light boxes and troughs. Manufacturers are making strenuous efforts to meet this requirement also.



Courtesy Library Bureau Division, Remington Rand, Inc., New York

TABLE CASE WITH MANUFACTURER'S INSTALLATION OF LIGHTING EQUIPMENT INSIDE BACK AND FRONT



WALL OR CENTER CASE WITH MANUFACTURER'S PROVISION FOR SELF-LIGHTING FROM TOP INSTALLATION

Courtesy Library Bureau Division, Remington Rand, Inc., New York

The best results that museums themselves can devise are obtainable with recessed wall cases. The housings of such cases serve well as screens to shield lamps and reflectors placed above or at the sides of the cases. In fact, the simplicity of lighting recessed cases seems to be a large factor in producing the present general adoption of cases of this type instead of free-standing wall cases. Free-standing cases are lighted best if they have low tops that allow for overhead fixtures, and high bases that shorten the distance of light travel; but there is a tendency to take even these cases into housings with diaphragm fronts, to make them like recessed cases. Center cases that do not rise much above eye level can be lighted from a surmounting light box or a cornice-like reflecting trough, both obtainable from the dealers. Table cases may be lighted from a trough reflector at one or more edges of the top.

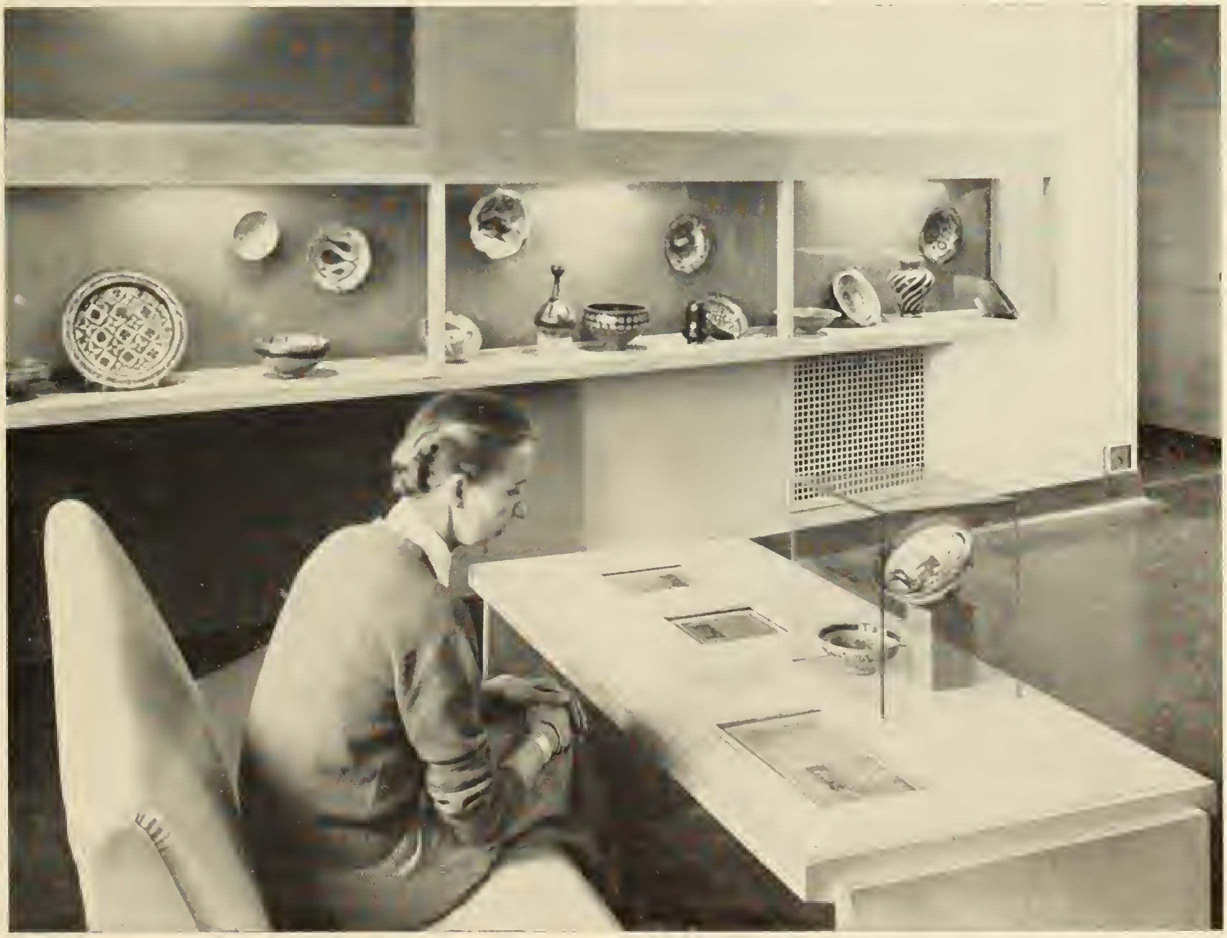
Group cases—that is, cases for dioramas and habitat groups—are, in principle, recessed cases. Small cases of this kind, such as might take a miniature diorama or a group of small mammals or birds, may in fact be regular recessed cases; but cases for large groups have to be specially built. The most the architect can do to meet the needs of large groups is to give a clear height, under beams, of at least 17 feet for groups of large mammals, although from 12 to 16 feet will be enough for most smaller groups. Whatever its size, space for any group should be at least as deep as it is high, since effects of distance may call for long lines of sight from front to painted background. Small groups and small-scale dioramas are more and more preferred to the very costly type of larger group, and for such smaller installations no exceptional space allowances are required. There should be adequate electrical outlets, although the actual lighting of groups is a preparator's problem. Never should provision be made for lighting groups of any kind, even in part, by natural light. However, a room containing groups may or may not have natural lighting as part of its room lighting scheme, provided that no light opening is placed where it will be reflected in the glass fronts of cases. For construction and lighting of groups cases, reference is made to *Building the Museum Group* by Albert E. Butler, American Museum of Natural History, Guide Leaflet No. 82.

Exhibition screens are very useful to give added exhibition surface, and also for membering long walls and dividing floor space. Dimensions of screens must relate to the scale of surroundings. A height of 7½ or 8 feet is common; but 7-foot screens may be best among cases of that height, and even 9-foot screens may be required for use as offsets to walls with a wide exhibition zone for large pictures. Very high screens extending to a high ceiling, or to bottoms of overhead beams, are most unsightly. For screens of moderate height, lengths to 10 feet are common; but this too must be in step with other things. Even thickness is a relative matter, since thin screens that are easy to move may not be massive enough in their appearance to sustain the character of displays. On the whole, a thickness of one foot seems to be about right for screens of some such size as 8 by 10 feet. One museum has V-shaped screens that rest on a leg at the narrow edge and have hooks engaging wall plates. But ordinarily the base of a screen is rectangular, and either rests on the floor or on four or six legs of the height of the toeboard in the room. All lines should be simple, without cornices and other elaboration. Edges of screens may be square, or one edge or both may be rounded, according to taste and to the uses planned. Fabric or other surfacing may be employed. The tops of thick screens may have recesses equipped with lamps and reflectors for indirect room lighting.

Seats for visitors offer more opportunities than have yet been exploited. The axial bench or settee is common in picture galleries. The National Gallery has comfortable, upholstered settees with cushion seats in its principal galleries. For people who want to sit close to objects on vertical display, many museums have provided small chairs or stools that can be pulled around; some of these, as at Providence, Hartford, and Kansas City, offer examples of modern furniture design. It has been suggested that vertical exhibition cases have benches so placed that sitters (perhaps with leaflets in hand) can examine at leisure while passers on foot can look, from farther back, over their heads—which would call for exhibits designed and labeled in correspondingly new ways. Also it has been said that there might be table cases especially made for sitters, each case with its stool kept underneath and its attached leaflet kept on top. The Cincinnati Art Museum has recently made some notable beginnings of this kind.

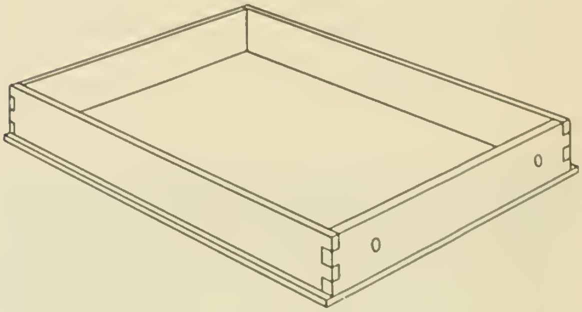
Small chairs and tables, of sizes appropriate to the age groups concerned, are required in children's museums and in the rooms of junior departments of public museums. Small cases have to be specially made.

AN EXHIBIT INSTALLATION FOR SEATED VISITORS. CASES OF EXPERIMENTAL DESIGN AT CINCINNATI ART MUSEUM. EXHIBITS INSTALLED IN REMODELED INTERIORS

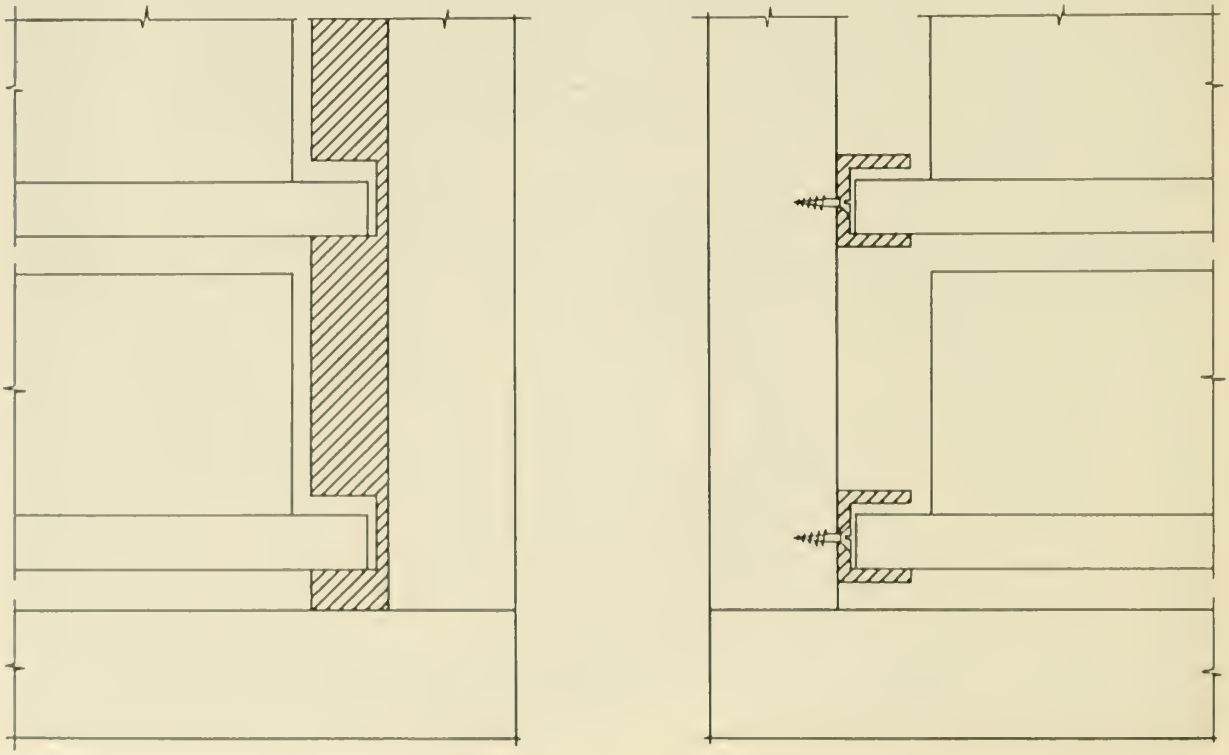


CURATORIAL EQUIPMENT required in live storages for the accommodation of collections, may consist of shelves, stacked trays, cabinets, picture racks and perhaps other kinds of special furniture. The requirements depend upon the nature of the material to be stored, and differ therefore from department to department and from museum to museum. Curators usually regard the development of such facilities as within their immediate province, and each curator is familiar with types of equipment used in his particular field. The actual growth of collections is what should set the pace for provisions beyond the more or less temporary arrangements a museum gets when it takes possession of a building. Thus, with certain exceptions, the architect's duty ends with giving suitable storage space that is well arranged for use and for expansion. The failure of building committees and architects to do this far outweighs any mistake or omission that could be made in the realm of shelves and racks.

There are several kinds of equipment in general use. The best known types are tiers of specimen trays and metal shelving, used chiefly by science museums, and series of sliding picture racks, used chiefly by art



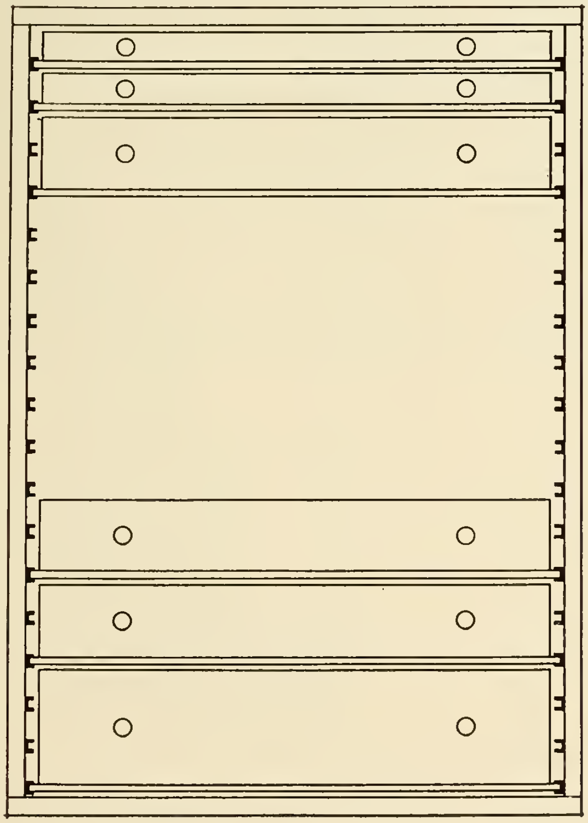
(RIGHT) SIMPLE STORAGE TRAY FOR SMALL THINGS (BELOW) DETAILS OF TWO TYPES OF RACKING IN CABINET OF WOOD WITH WOOD OR METAL RUNNERS



museums. A new building should have its storages laid out for such equipment, as required. At the start there may be only small installations of specimen trays and shelves, or of picture racks, with the necessary supports.

Specimen trays, used for materials of nearly all science and history departments, and for small objects of art, are usually of $\frac{3}{4}$-inch pine, with $\frac{3}{8}$-inch masonite bottoms. Unit trays are commonly 20 by 24, 24 by 30, or 24 by 36 inches outside, although there are other sizes to be found. Depths are 2, 4, or 6 inches or more (less $\frac{1}{4}$ inch for clearance when trays are racked close together). The masonite bottom extends $\frac{1}{2}$ inch beyond the edge of the tray at each side, to run on wooden or metal cleats in racking or cabinets. A simple construction is illustrated. Unit cabinets, to take the trays, may be of wood, or of metal with steel angle frames covered with sheet steel. They may have open fronts, or tight front panels held by lugs and catches, as dictated by the character of the material stored. Cabinets 38 inches high are convenient as work counters also, and alternatively they may be piled in two ranges one above the other; or cabinets are sometimes 76 inches or more high in one piece.

WOOD CABINET WITH RUNNERS OF METAL CHANNEL AND INTERCHANGEABLE TRAYS OF THREE DEPTHS

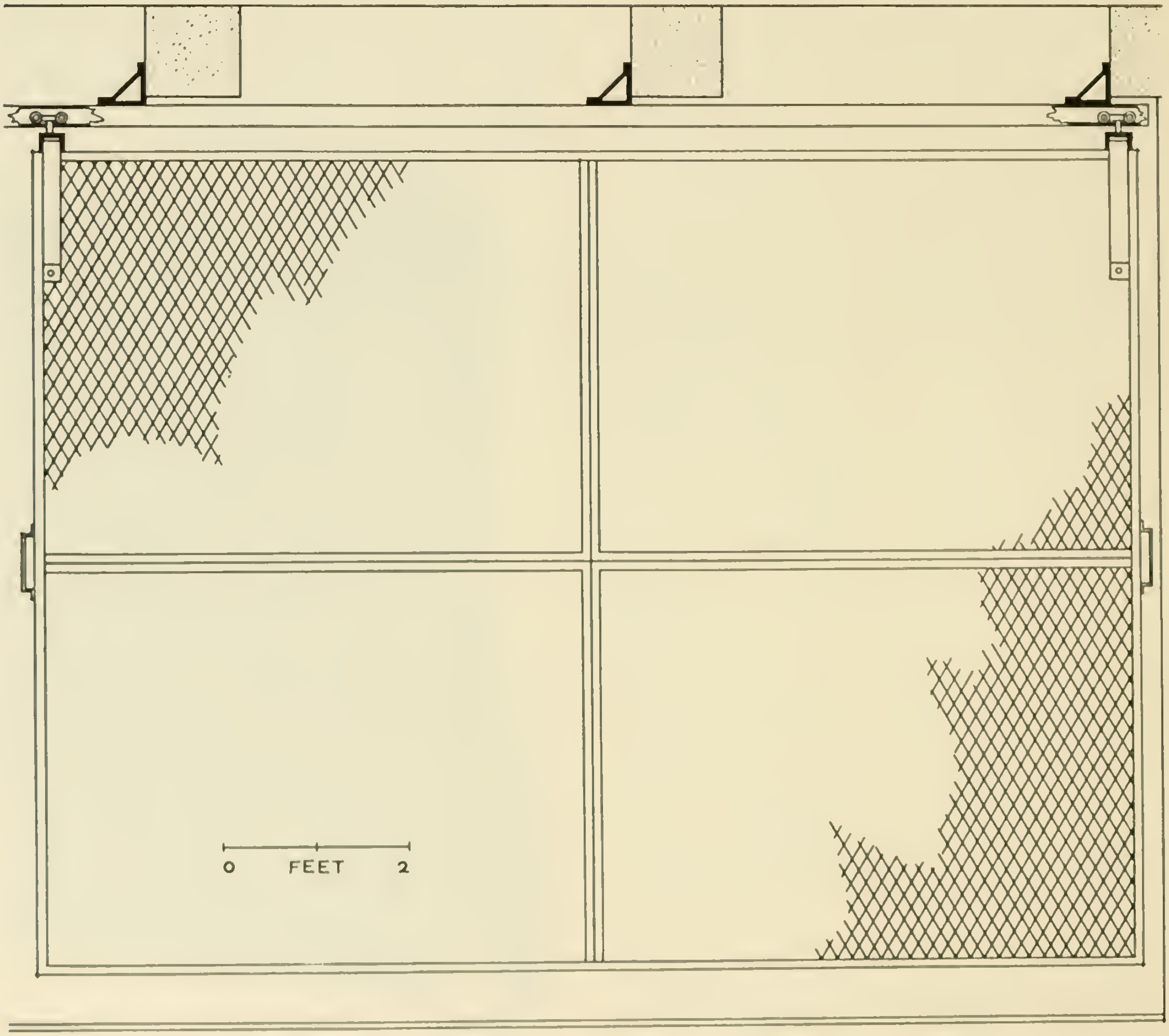


Metal shelving for storage of specimens in alcohol and other objects, in study storage,

METAL CABINETS WITH DOORS AS MADE TO ORDER FOR UNIVERSITY OF ROCHESTER GEOLOGY MUSEUM

Courtesy Yawman and Erbe Mfg. Co., Rochester, N. Y.

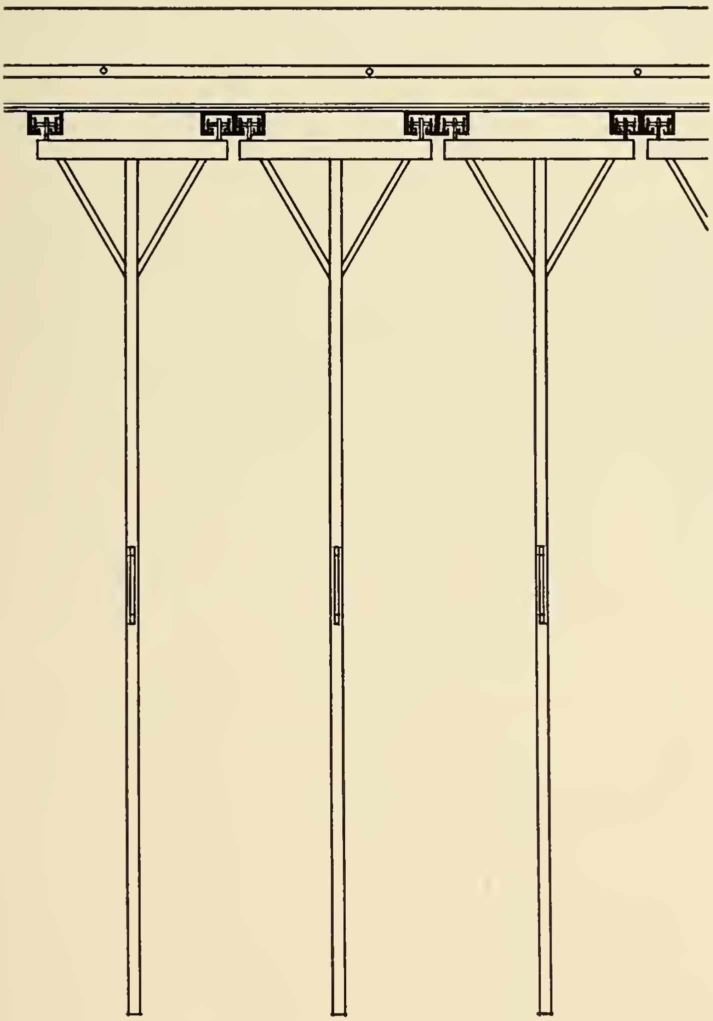
may be of special design. However, standard steel shelving, such as is used commercially in stock rooms, can serve the purpose admirably. Shelves of this kind are commonly 36 inches long and of widths from 9 to 36 inches, fitting into uprights that come in heights up to 10 feet or more and are either of open construction (of steel angles) or of bin-type construction (with added sheet steel sides and partitions, and backs also if they are wanted). Shelves in the usual position are carried on lugs that engage holes in uprights. If shelves with marginal rims are needed to keep objects from being jarred off or otherwise displaced and perhaps broken, the shelves can be put in place *upside down* so that the reinforcing edges all around will stand up like the sides of a tray. This very useful method of assembly requires holding of shelves not by their lugs but by bolts set in holes that are provided in standard equipment. If desired, to prevent rusting or corro-



sion of the metal after paint is worn off, a slab of thin composition board, cut to size and perhaps notched at places of bolting, may be laid on the bottom of each tray-like inverted shelf. Shelving of standard and special types may be purchased from Remington Rand in New York, or from many other manufacturers including Peerless Steel Equipment Company in Philadelphia.

Storage space that is to be equipped with shelving of any kind may well be designed in the same way as standard library stacks—with several shallow levels of space between each two reinforced concrete floors (page 163).

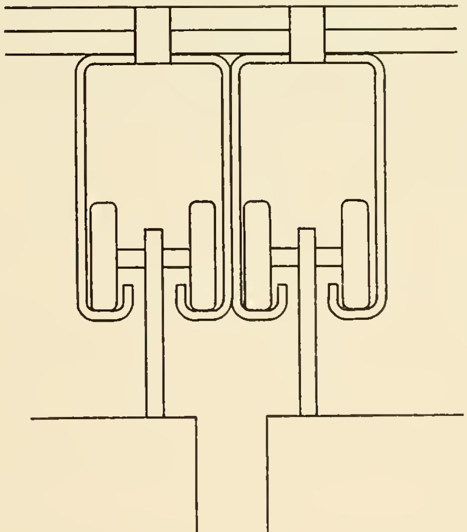
Picture racks, for storage of paintings with or without their frames, are used in art museums and history museums. These racks are made in large rectangular units, having steel channel frames with expanded metal or woven wire mesh. The units are supported in series in a vertical position, each unit mounted with rollers on overhead tracks so



MOVABLE RACKS FOR STORING OF PAINTINGS—SIDE AND END (OPPOSITE AND LEFT)

(BELOW) DETAIL OF TRACKS. SEE ILLUSTRATION PAGE 178

Data from Cleveland Museum of Art



that it can be drawn out in the plane of its stored position. Such racks seem to have been used first at Cleveland in 1916, although stationary storage screens had been developed earlier at Boston and elsewhere. Cleveland's racks, designed by Superintendent James F. McCabe, are 9 feet high and 12 feet long and clear the floor by 6 inches. They are bracketed above at each end to run on two overhead tracks so that uneven weighting will not swing them out of position. The distance between racks is approximately 2 feet, and the space in which the racks are installed should allow for drawing each unit all the way out and should have some room to spare for reference work.

Efforts have been made to improve on this pattern. The wheels have been put on one runner, and the racks kept from swinging by a gutter in the floor. This arrangement, seen at the Frick Collection, New York, allows for closer spacing of racks. Again, racks have been mounted with rollers below, running on a floor track, and with only a guiding channel at the top. This construction, adopted at the National Gallery, keeps all lubrication near the floor and thus prevents dripping of oil; but it makes an uneven floor that is hard to clean. Hinging of frames has been tried, but without success. The Freer Gallery in Washington has a motor-drive mechanism for rolling out the racks—which chiefly succeeds in complicating something perfectly simple.

The Cleveland scheme is still good, and examples of it are seen also at Cambridge, Toledo, Omaha, and elsewhere. The construction is illustrated. It has been suggested that racks be reduced in height to 7 or 8 feet and in width to perhaps 9 feet, with less space—perhaps 18 or 20 inches—between them.

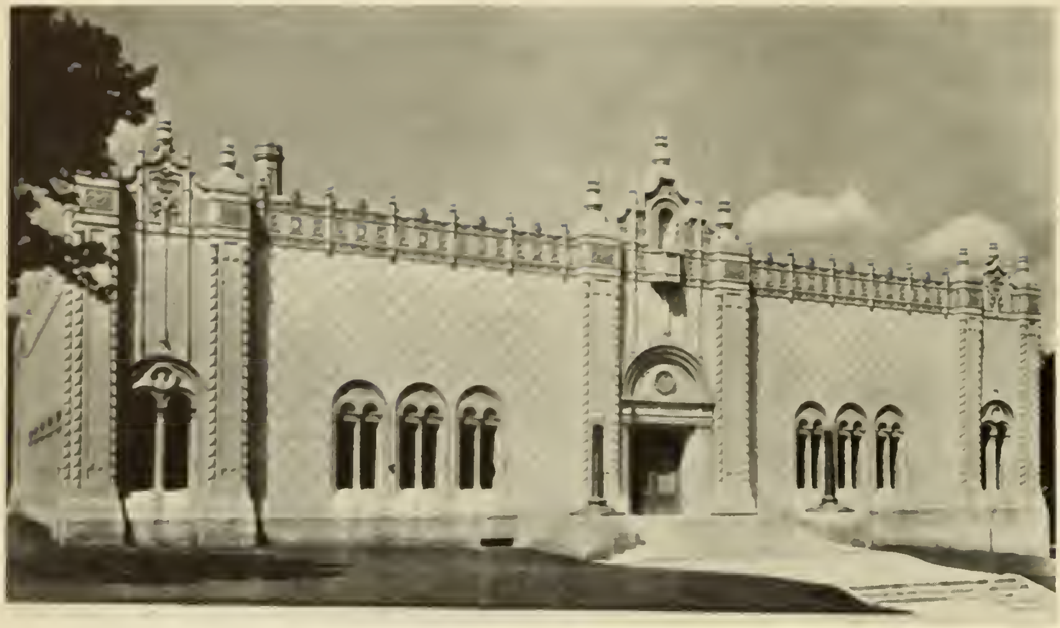
The recommended filling for the steel channel frames is of standard 1½-inch woven wire diamond mesh, such as is used for partitions. A leaflet on *Woven Wire Products*, available from Acme Iron Works, Washington, D. C., shows the manufacturer's methods of framing and attachment.

A fumigating chamber is another piece of curatorial equipment that every museum has need of, though only the better appointed museums possess. This is for use at intervals by any curator who finds dermestes beetles, clothes moths, silverfish, or other pests infesting collections in his care, and it is for use regularly by the registrar to fumigate incoming accessions and borrowed things—whether furs or textiles that might conceal pests or a piece of antique furniture hopping with fleas. Almost any large tank, having a wide opening capable of being sealed, would do after a fashion for this purpose; but the right provision is a special chamber made so that a hand truck can be wheeled in, the chamber then being hermetically closed and later exhausted to the out-of-doors. The National Museum is not alone in having constructed such a chamber of metal in its own shops; its apparatus is provided with small heaters under automatic control to maintain temperature at 75°F during use, an interior light, an observation window, a separate aperture with air-tight lid for putting in fumigant, and a fan and duct to take out the mixture of air and noxious gas when the fumigating is finished.

There are several museums with fumigators, purchased complete, and installed by the manufacturer. The Chicago Natural History Museum, among other museums, has a unit made by the Haskelite Manufacturing Corporation, Chicago, equipped with auxiliary apparatus to maintain temperature, force circulation of fumigant gas, and aerate the chamber after use. This device has double metal walls, and is designed to hold a concentration of gas at 75°F for 24 hours. The door mechanism and other moving parts are of noncorroding monel metal. The standard size of this make is 4′6¼″ by 6′7″ high, and the door is 36″ wide and 73″ high. The Allan Hancock Foundation of Los Angeles, and several other institutions with very recent equipment, have vacuum fumigators of a type manufactured under the trade name *Vacu-Fume* by the Union Tank and Pipe Corporation, Los Angeles. This apparatus creates a partial vacuum before the fumigant gas is introduced, and it thus performs its task in two or three hours. The chamber adopted by the Foundation is rectangular; but there is also a cylindrical type. Either type of equipment can be supplied in several sizes.

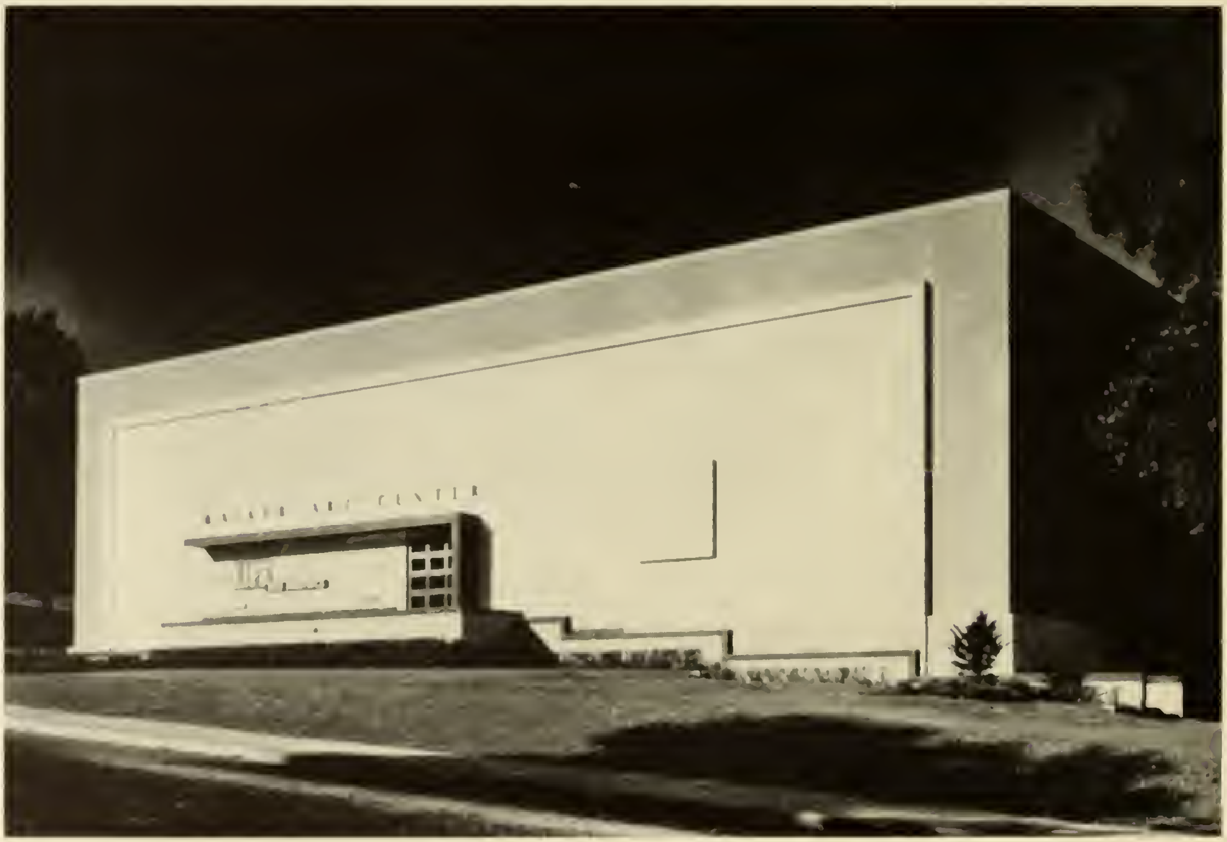
The fumigating chamber is usually under the care of the registrar, who should be responsible for the presence of at least two people whenever it is used. Several fumigants, including hydrocyanic acid gas, are employed; but a recommended medium is marketed as Dowfume No. 50 by the Dow Chemical Company of Midland, Michigan.

The most advantageous place for this unit would seem to be near the upper reaches of the freight elevator, where it is both accessible and out of the way.



WALKER ART GALLERIES (1927) LONG AND THORSHOF, ARCHITECTS. THE BUILDING BEFORE ITS REMODELING
Courtesy Walker Art Center, Minneapolis

WALKER ART CENTER AFTER ENTIRE REMODELING (1944) BY MAGNEY, TUSLER AND SETTER, ARCHITECTS



CHAPTER XX. REMODELING

An old building cannot be changed into an up-to-date building by making alterations. The best to be hoped for is a more or less up-to-date looking thing, without some of the drawbacks of the original form but still outmoded in essentials. A great deal of the remodeling that goes on is really ill-advised. After all, the normal life of a public building is not much over fifty years, unless history has chanced to create some unusual cause for preserving the building in its original form. Nearly a hundred of the older museum buildings have already passed the half-century mark, and an even larger number of the museums now standing are to pass the same mark in each of the next few decades. This may well encourage some added demolition and the taking of fresh starts instead of what might otherwise be patchwork and further patchwork. The same thought has occurred to librarians. "If one thousand assorted old library buildings could be bombed without injuring any individuals, and replaced with modern structures," wrote Joseph Wheeler of Baltimore in his ALA bulletin on *Postwar Library Building*, "it would have a salutary and refreshing influence on the American library movement."

Alteration of museums is undertaken as a rule to save money, although new construction may be what is really wanted. Minor changes may not be of this ilk; but many a remodeling, such as comes when a building is just too antiquated to be put up with any longer, is a sheer measure of economy. More than that, it is often a measure of *false* economy, since the product is still a makeshift and may in the long run prove to be more costly than has been planned. Every contractor knows that additions to an old building cost less than alterations. And every museum board should know, if only from the experience of others, that a remodeled building is full of chances for operating waste to pile up year after year.

Remodeling will surely go on, and it may well aim at approximating conditions such as foregoing chapters have aimed to suggest. Exterior walls can be simplified by removal of stylistic ornament, but no amount of effort to treat an old façade in modern style can do more than turn it into modernistic veneer on a still old piece of architectural construction. Most old buildings can be made more fire resistant in some parts, and more weather resistant in others. Interiors can be simplified also, much to the advantage of exhibits in a place that is cluttered with the accustomed decoration. Uses of stories can sometimes be changed, and mezzanine floors may be introduced in some places. Other practical improvements can often be brought about, as by removing masses in the way such as a staircase blocking the lobby, or by adding needed conveniences such as a staff stairway, or by relocating nonbearing partitions and reshuffling uses of space to give more functional arrangements. In a limited way, old lighting installations can be replaced by new—with as much recognition of present methods as existing plan, scale, fenestration, skylighting, construction, and other stubborn realities will permit. Light openings may be closed, or perhaps even introduced in new positions if the façade does not veto such changes. Hung ceilings may perhaps be engineered. Floorings can be replaced. More or less of air conditioning can be instituted as a rule. And a physical plant can be doctored somewhat to meet any new demands upon it. These are all half-measures, but they help.

There have been cases of heroic remodeling among museums large and small. The New York Historical Society's building of 1908 was completely overhauled more than a decade ago. During the 'thirties, the Museum of Science and Industry, Chicago, built a modern interior within a famous Neo-Classical shell of 1893. At the same time the Neo-Classical Brooklyn Museum had its interior partly reconstructed on modern lines, and also had its façade changed somewhat and its approaching steps demolished. The Springfield Natural History Museum and the Berkshire Museum, both in Massachusetts, the John Herron Art Museum in Indianapolis, the Walker Art Center in Minneapolis, and the Everhart Museum in Scranton are among the smaller museums that have had extensive remodelings. The Cincinnati Art Museum is even now reversing the past as best it can, step by step. And in store for the years to come are the projected remodelings of New York's vast American Museum, Metropolitan Museum and Brooklyn Museum.

The normal completing of displays in some museums has amounted to a kind of remodeling, long protracted. A well known example of this has been given, almost continuously since 1928, by the Philadelphia Museum of Art which now has a carefully studied museum structure within a noncommittal shell that the architects designed before enough was known of the future.

CONVERTING OF HOUSES and other non-museum structures into museum homes, temporary or permanent, may be any of a number of varied tasks. It may be a mere altering job, to make rooms built for living or cooking or eating or sleeping serve for museum display, administration, educational work. It may be a matter of adapting some esteemed building to a use that will let it live on in a not too changed condition. Or it may be the assignment of preserving and perhaps restoring some structure worthy of being a true historic house museum. The last of these possibilities is a special commission of trust that calls for restraint, perhaps research, and surely knowledge of the history of design and building. The second possibility is likely to be a frustrating task that ends by leaving the façade about as it was and dealing with the interior by an altering job of the first-named category.

Making a former residence into a home for a museum is a highly unsatisfactory kind of remodeling work. Probably the soundest reason for undertaking it is the hope of preparing the way, in the life of some growing institution, for a future museum building. But, even so, the trustees would do well to learn the full cost of making the alterations proposed, and to compare this with the cost of putting up at least the first part of a suitable permanent structure. Museums, and libraries too, have often been cautioned against accepting too hastily a gift of property that may turn out to be more of a burden than a benefaction. Not a few gift houses have been found valuable chiefly as pieces of land.

What the great cleric, Richard Hooker, wrote some centuries ago is still true: "Alteration, though it be from worse to better, hath in it inconveniences, and those weighty."

APPENDIX

APPENDIX. MUSEUM BUILDINGS (1814-1949)

The following chronology lists buildings designed or largely remodeled for museums. All dates are dates of opening. Each building is shown under the year of its earliest part, or of its earliest part put up for museum purposes. Italics indicate buildings no longer occupied by museums, most of them torn down. All items are indexed under localities.

1806 *Pennsylvania Academy of the Fine Arts, Philadelphia, Pa. Attributed to Benjamin Henry Latrobe. Building at Tenth ana Chestnut Streets, destroyed by fire in 1845. For present building see 1876.*

1814 Peale's Museum, Baltimore, Md. Occupied as museum and residence of Rembrandt Peale, later of Reubens Peale until 1830. Used as city hall 1830–76, and thereafter for sundry commercial purposes until restored in 1931. Now occupied by Municipal Museum of the City of Baltimore. Architect: Robert Cary Long, Baltimore. Architect of restoration: John H. Scarff of Wyatt and Nolting, Baltimore.

1815 *Academy of Natural Sciences of Philadelphia, Philadelphia, Pa. Temporary building put up by Jacob Gilliams on lot behind his father's house on Arch Street, east of Second Street. Occupied until 1826.*

1818 *William Clark Indian Museum, St. Louis, Mo. Brick wing of Clark's residence. Demolished after 1838.*

1819 *Cabinet Building, Yale University, New Haven, Conn. Two story building with dining hall below. Mineralogical and Geological Cabinet on second floor. Known as Cabinet Building after 1842 when Commons was given up. Building used for museum purposes until 1876 when old Peabody Museum was built.*

1824 Pilgrim Hall, Pilgrim Society, Plymouth, Mass. Architect: Alexander Parris. Cost: $5,000. Additions: 1904, $4,000; 1921, McKim, Mead and White, New York, N. Y., $50,000.

1826 *Gallery of Boston Athenaeum, Boston, Mass. Building back of Perkins Mansion on Pearl Street in which Athenaeum was then housed. Vacated 1849.*

1831 *American Academy of Fine Arts, New York, N. Y. Gallery and school building at 8 Barclay Street. Sold 1841.*

1832 *Trumbull Gallery, Yale University, New Haven, Conn. Occupied as art museum until 1868. Demolished 1901. For present Yale University Art Gallery see 1928.*

1840 *Academy of Natural Sciences of Philadelphia, Philadelphia, Pa. Old building at Broad and Sansom Streets; addition of second floor 1847. Vacated 1876. For present building see 1876.*

1844 *Rhode Island Historical Society, Providence, R. I. Architect: James C. Bucklin. Cost: $50,000. Sold to Brown University 1942.*

1844 *Wadsworth Atheneum, Hartford, Conn. Addition 1890. Occupied as art museum until Morgan Memorial was built in 1910. Now used as public library, with quarters of Connecticut Historical Society. Architect: Ithiel*

Town. For other buildings see 1910, 1934.

1846 *Appleton Cabinet, Amherst College, Amherst, Mass. Occupied until 1908 when present Amherst College Museum was built; Cabinet remodeled for recitation building 1922.*

1855 Smithsonian Institution, Washington, D.C. Architect: James Renwick, Jr. Cost: $300,000.

1859 *Corcoran Gallery of Art. See 1874.*

1860 Museum of Comparative Zoology, Harvard University, Cambridge, Mass. Plans by Henry Greenough and George Snell. Additions: 1872, 1877, 1882; additions of 1889, 1902—occupied by other branches of the University Museum—connect with Peabody Museum, for which see 1877.

1864 *Boston Society of Natural History, Boston, Mass. Old building on Berkeley Street, sold in 1947 and used as a department store. Architect: William G. Preston. Cost: $100,000. New building, Boston Museum of Science, projected.*

1864 International Falls Museum, Niagara Falls, N. Y. A museum for profit, of some historical interest.

1864 Wagner Free Institute of Science, Philadelphia, Pa. Architect: John McArthur, Philadelphia.

1865 *National Academy of Design, New York, N. Y. Gallery and school building at 4th Avenue and 23rd Street. Sold in 1894 or 1895 and torn down.*

1868 *Chicago Academy of Sciences, Chicago, Ill. Old building at 265 Wabash Avenue. Destroyed by fire in 1871. For present building see 1894.*

1872 Museum, Judd Hall, Wesleyan University, Middletown, Conn. Architects: Bryant and Rogers. Cost: $40,000.

1873 E. B. Crocker Art Gallery, Sacramento, Calif. Addition to residence. Cost: $235,000. Residence remodeled and opened as annex 1924. Cost of remodeling: $40,000.

1873 St. Johnsbury Atheneum, Gallery, St. Johnsbury, Vt. Wing of library building of 1871. Architect: John Davis Hatch, New York, N. Y. Cost of wing: $10,000.

1874 *Corcoran Gallery of Art, Washington, D. C. Old building at Pennsylvania Avenue and 17th Street. Built in 1859 but occupied first by Army during Civil War and not opened until 1874. Vacated 1897 and sold 1901. Architect: James Renwick, Jr. For present building see 1897.*

1876 Academy of Natural Sciences of Philadelphia, Philadelphia, Pa. Architect: John T. Windrim, Philadelphia. Cost: $194,000. Remodeling and additions: 1894 and 1908, Wilson, Harris and Richards, $500,000.

1876 Memorial Hall, Fine Arts Building of Centennial Exposition, Philadelphia, Pa. Architect: Hermann Joseph Schwartzman. Cost: $1,500,000. Reopened as Pennsylvania Museum, see 1877.

1876 *Museum of Fine Arts, Boston, Mass. Old building at Copley Square; additions 1878, 1888. Vacated 1909 and sold. Architect: John H. Sturgis. Cost: $625,000. For present building see 1909.*

1876 *Peabody Museum of Natural History, Yale University, New Haven, Conn. Old building on High Street. Demolished in 1917. For present building see 1926.*

1876 Pennsylvania Academy of the Fine

Arts, Philadelphia, Pa. Architects: Furness and Hewitt. Cost: $543,000.

1877 American Museum of Natural History, New York, N. Y. First unit, now rear wing of south pavilion. Architect: Calvert Vaux. Cost: $700,000. Additions: 1892–1894, south facade, J. C. Cady and Company, $1,912,000; 1899–1900, two south corner pavilions and auditorium, Cady, Berg and See, $1,164,000; 1902–1909, southwest wing, heating and power plant, Charles Volz, $814,000; 1911–1921, including southeast wing, Trowbridge and Livingston, $1,700,000; also 1923, School Service Building, $692,000; 1931, services structure, $1,650,000; 1935, African Wing, $1,000,000; 1935, Whitney Memorial wing, $1,500,000; and 1935, Hayden Planetarium, $650,000, all by Trowbridge and Livingston; 1935, Roosevelt Memorial, John Russell Pope, $3,687,000. Total cost: $15,469,000. Extensive remodeling projected.

1877 Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Mass. Architect: Robert H. Stack. Cost: $53,000. Additions: 1889, Stone, Carpenter and Willson, $33,000; 1914, Walter S. Burke, $98,000. Connecting with Museum of Comparative Zoology, for which see 1860.

1877 Pennsylvania Museum (now Philadelphia Museum of Art), Philadelphia, Pa. Same as Memorial Hall 1876. For later buildings see 1928 and Rodin Museum 1929.

1878 Davenport Public Museum, Davenport, Iowa. Cost: $4,500. Additions: 1900, 1930.

1879 Allen Steinheim Museum, Alfred University, Alfred, N. Y.

1879 Portland Society of Natural History, Portland, Me. Architect: Frederick H. Fassett. Cost: $20,000.

1879 Lewis Brooks Museum, University of Virginia, Charlottesville, Va. Architect: J. R. Thomas, Rochester, N. Y. Cost: $40,000.

1880 Long Island Historical Society, New York, N. Y. Architect: George B. Post. Cost: $135,000.

1880 Metropolitan Museum of Art, New York, N. Y. First unit, central part of west block. Architect: Calvert Vaux. Cost: $519,000. Additions: 1888, Theodore Weston and Arthur L. Tuckerman, $497,000; 1894, completing west block, Arthur L. Tuckerman and Joseph Wolf, $413,000; 1902, entrance unit on Fifth Avenue, Richard Morris Hunt and Richard Howland Hunt, $1,084,000; 1909, Wing E north of entrance, $444,000; and 1910, Wing F north of west block, $443,000; also 1914, Wing H north of Wing E, $820,000; 1917, Wing J south of entrance, $516,000; and 1926, Wing K south of Wing J, $1,013,000—all five (1909–1926) by McKim, Mead and White; 1924, American Wing, Grosvenor Atterbury, $197,000; other additions since 1910, $1,594,000. Total cost: $7,540,000. Extensive remodeling projected. For The Cloisters see 1938.

1880 Smith College Museum of Art, Northampton, Mass. Hillyer Gallery. Architects: Peabody and Stearns. Cost: $25,000. Additions: 1912, Charles A. Rich, $30,000; 1926, Tryon Gallery, Frederick L. Ackerman, New York, N. Y., $100,000.

1881 Cincinnati Art Museum, Cincinnati

Museum Association, Cincinnati, Ohio. Architect: J. W. McLaughlin. Cost: $534,000. Additions: 1907, Schmidlapp Wing, D. H. Burnham Company, $127,000; 1930, Emery Wing, $307,000, and 1930, French Wing, $102,000, and 1930, Hanna Wing, $118,000, all three by Garber and Woodward; 1937, Alms Wing, Panzer and Martin, $360,000. Remodeled 1949, Redigs, Panzer and Martin, Cincinnati.

1881 *St. Louis Museum (now City Art Museum) and School of Fine Arts, St. Louis, Mo. Old building at 19th and Locust Streets. Vacated in 1906. For present building see 1904 and 1906.*

1881 United States National Museum, Arts and Industries Building, Washington, D. C. Architects: Cluss and Schulze. Cost: $225,000. For Natural History Building see 1911.

1882 *Museum of Natural History, University of Michigan, Ann Arbor, Mich. Old building. Vacated in 1928. For present building see 1928.*

1882 Vassar Brothers Institute, Poughkeepsie, N. Y.

1884 Barnum Museum, Tufts College, Medford, Mass. Architect: J. P. Rinn. Cost: $56,000.

1885 Academy Hall, Peabody Academy of Science (now Peabody Museum of Salem), Salem, Mass. Extension of East India Marine Hall, built 1824 as meeting and business place and bought by Academy 1868. Architects of extension: Stone, Carpenter and Willson. Cost: $40,000. Addition: Weld Hall, Peabody and Stearns, $60,000.

1886 Telfair Academy of Arts and Sciences, Savannah, Ga. Gallery addition to mansion of 1818. Architect of gallery: Detlef Lienau.

1887 *Army Medical Museum (and Army Medical Library), Washington, D. C. Architects: Cluss and Schulze. Cost: $200,000. Museum moved to temporary quarters 1945. Building now occupied by Armed Services Institute of Pathology.*

1887 *Art Institute of Chicago, Chicago, Ill. Old building at Michigan Avenue and Monroe Street occupied until 1893. For present building see 1893.*

1888 Dedham Historical Society, Dedham, Mass. Architect: Edwin J. Lewis, Jr. Cost: $13,000.

1888 *Detroit Museum of Art (now Detroit Institute of Arts), Detroit, Mich. Old building at 704 Jefferson Avenue. Cost: $66,000. Additions: 1883, 1897, 1904, total $227,000. Vacated 1927. For present building see 1927.*

1888 Layton Art Gallery, Milwaukee, Wis. Architects: G. A. Audsley and E. Townsend Mix Company. Cost: $90,000. Addition: 1915, William H. Schuchardt, Los Angeles, Calif., $11,000.

1888 Slater Memorial Museum, Norwich Free Academy, Norwich, Conn. Architect: Stephen C. Earle, Worcester, Mass. Cost: $500,000.

1889 Art Gallery, James Prendergast Free Library, Jamestown, N. Y. Wing of library. Architects: Warner and Brockett, Rochester, N. Y. Cost: $45,000.

1889 Farnsworth Museum of Art, Wellesley College, Wellesley, Mass. Architects: Rotch and Tilden. Cost: $112,000.

1889 Museum of Historic Art (now Art Museum), Princeton University, Princeton, N. J. Architect: A. Page

Brown. Cost: $50,000. Additions, with remodeling of McCormick Hall, 1935.

1890 William Long Memorial, New Hampshire Antiquarian Society, Hopkinton, N. H. Architect: William J. Gilbert of Cram, Wentworth and Goodhue. Cost: $20,000.

1891 *California Academy of Sciences, San Francisco, Calif. Old museum and office building at 833 Market Street. Destroyed by fire 1906. For present building see 1916.*

1891 Fairbanks Museum of Natural Science, St. Johnsbury, Vt. Architect: Lambert H. Packard. Cost: $100,000.

1891 Louisiana Historical Association, New Orleans, La. Architect: Thomas Sully.

1891 Worcester Historical Society, Worcester, Mass. Architects: Barker and Nourse. Cost: $28,000.

1892 Leland Stanford Junior Museum, Stanford University, Palo Alto, Calif. Cost: $564,000.

1893 Art Institute of Chicago, Chicago, Ill. Architects (1893–1930): Rutan, Shepley and Coolidge, Boston, Mass. Cost: $632,000. Principal additions: 1899, Fullerton Hall, $90,000; 1900–1904, including Ryerson Library and Blackstone Hall, $202,000; 1905–1909, $125,000; 1910–1914, $193,000; 1915–1919, $215,000; 1920–1924, including Hutchinson Wing, $960,000; 1925–1930, including Goodman Theatre, Mather Additions and Burnham Library, $657,000. Allerton Wing, 1939, Holabird and Root, Chicago, $123,000. Total cost: $3,197,000.

1893 *Art Palace, World's Columbian Exposition, Chicago, Ill. Occupied by Field Museum of Natural History 1893–1921. Reconstruction begun 1929 by Museum of Science and Industry resulted in practically new building, for which see 1933.*

1893 *English Memorial, New Haven Colony Historical Society, New Haven, Conn. Old building at 144 Grove Street. Vacated 1931. For present building see 1931.*

1893 Museum of Art, Rhode Island School of Design, Providence, R. I. Architects: Hoppin and Ely. Additions: 1897, $75,000; 1906, period house, Edmund R. Willson of Stone, Carpenter and Willson, $50,000. For Radeke Building see 1925 (William T. Aldrich, Boston, $500,000).

1893 Walker Museum of Paleontology, University of Chicago, Chicago, Ill. Architect: H. I. Cobb. Cost: $110,000.

1893 Wistar Institute of Anatomy and Biology, Philadelphia, Pa. Museum and laboratory building. Architects: G. W. and W. D. Hewitt. Addition 1897.

1894 Matthew Laflin Memorial, Chicago Academy of Sciences, Chicago, Ill. Architects: Normand S. Patton and Reynolds Fisher. Cost: $100,000. For earlier building see 1868.

1894 M. H. De Young Memorial Museum, San Francisco, Calif. Building of California Midwinter Exposition of 1894, now entirely replaced except for storage unit. Additions: 1917, $90,000; 1919, $165,000; 1924, $110,000—all three by Louis Mulgardt. Also, 1930, Frederick H. Meyer, San Francisco, $265,000. Complete remodeling under way.

1894 Thayer Museum, Lancaster, Mass. Architect: Henry Forbes Bigelow. Cost: $25,000.

1894 Walker Art Building, Museum of Fine Arts, Bowdoin College, Brunswick, Me. Architects: McKim, Mead and White, New York, N. Y. Cost: $380,000.

1895 Brooklyn Museum, Brooklyn Institute of Arts and Sciences, Brooklyn, New York, N. Y. First unit, west wing. Architects: McKim, Mead and White, New York. Cost: $348,000. Additions: 1905, central block, $692,000; 1907, east wing, $666,000; 1927, behind east wing, $1,445,000. Partial remodeling 1935, Philip N. Youtz; extensive remodeling and additions projected, Brown Lawford and Forbes, New York.

1895 Carnegie Institute, Pittsburgh, Pa. Building of Department of Fine Arts and Carnegie Museum. Architects: Alden and Hawlow. Cost: $1,000,000 for part now occupied by Carnegie Library. Addition: 1907, for Department and Museum, $5,000,000.

1895 *Fogg Art Museum, Harvard University, Cambridge, Mass. Old building vacated 1927 and now known as Hunt Hall, used by School of City Planning. For present building see 1927.*

1895 Park Museum, Providence, R. I. Architects: Martin and Hall, Providence. Cost: $40,000. Addition: 1916, $43,000.

1895 Thomas W. Wood Gallery of Fine Arts, Montpelier, Vt.

1896 *Chicago Historical Society, Chicago, Ill. Old building at Dearborn and Ontario Streets occupied until 1932. Still owned by Society and rented. For present building see 1932.*

1896 George Walter Vincent Smith Art Gallery (now Museum), Springfield, Mass. Architect: Walter Tallant Owen of Renwick, Aspinwall and Owen. Cost: $150,000.

1896 *Haskell Oriental Museum, University of Chicago, Chicago, Ill. Old building of present Oriental Institute, occupied until 1931 and now known as Haskell Hall, used by School of Business. For present building see 1931.*

1896 Oneida Historical Society, Utica, N. Y. Architect: Richard H. Hunt, New York, N. Y. Cost: $40,000.

1896 *Schenck Museum, Guilford Court House National Military Park, N. C. Torn down in 1937 when new park museum was opened.*

1897 Corcoran Gallery of Art, Washington, D. C. Architect: Ernest Flagg, New York, N. Y. Cost: $550,000. Addition: 1928, Clark Wing, Charles A. Platt, New York, $700,000. For earlier building see 1874.

1898 *Genesee Valley Museum, Castile, N. Y. Torn down in 1912 when Letchworth Park Museum was built.*

1898 Milwaukee Public Museum, Milwaukee, Wis. Architects: Ferry and Clas, Milwaukee. Cost: $471,000. Addition: 1912, $425,000. New building projected.

1898 Parrish Memorial Art Museum, Southampton, N. Y. Architect: Grosvenor Atterbury, New York, N. Y. Cost: $10,000. Additions: 1903, $20,000; 1913, $30,000.

1898 *Western Reserve Historical Society, Cleveland, Ohio. Old building vacated 1939.*

1898 Worcester Art Museum, Worcester, Mass. Architect: Stephen C. Earle. Cost: $95,000. Additions: 1922, $175,000; 1933, new building in front of 1898 structure, $748,000, both by William T. Aldrich, Boston, Mass.;

1939, connecting studios and penthouse, G. Adolph Johnson, Worcester, $225,000.

1899 Barnum Institute, Bridgeport Scientific and Historical Society, Bridgeport, Conn.

1899 Hitchcock Memorial Museum and Library, Westfield, Vt. Architects: George D. Story and Company, Newport, Vt. Cost: $10,000.

1899 Massachusetts Historical Society, Boston, Mass. Architect: Edmund M. Wheelwright, Boston. Cost: $180,000.

1899 Museum of Natural History, Springfield, Mass. Architects: Gardner, Pyne and Gardner. Cost: $30,000. Addition and remodeling: 1934, Edward Lippincott Tilton and Alfred Morton Githens, $225,000.

1899 Museums of New York Botanical Garden, New York, N. Y. Architect: Robert W. Gibson. Cost: $361,000.

1899 Philadelphia Museums (now Philadelphia Commercial Museum), Philadelphia, Pa. Two exhibit buildings, exposition hall, power plant, and storage house built for National Export Exposition. Cost: $950,000.

1899 University Museum, University of Pennsylvania, Philadelphia, Pa. Architects: Cope and Stewardson. Cost: $342,000. Additions: 1901, Day and Klauder, $247,000; 1916, Stewardson and Page, $387,000; 1929, Wilson, Eyre and McIlvaine, Philadelphia, $631,000.

1900 Hood Museum of Natural History, Alma College, Alma, Mich.

1900 Maine Historical Society, Portland, Me. Architect: Alexander W. Longfellow. Cost: $50,000.

1900 Natural History Museum, New Britain Institute, New Britain, Conn. Museum occupies top (2nd) floor, above library. Architect: William F. Brooks, New Britain. Cost: $100,000. For Art Museum of Institute see 1937.

1900 State Historical Society of Wisconsin, Madison, Wis. Architects: Ferry and Clas, Milwaukee. Cost: $610,000. Remodeling and additions projected.

1901 Robert Singleton Peabody Foundation, Phillips Academy, Andover, Mass. Architect: Guy Lowell. Cost: $61,000.

1901 Historical, Memorial and Art Department of Iowa (now Iowa State Department of History and Archives), Des Moines, Iowa. Architect: Oliver O. Smith of Smith, Wetherell and Gage. Cost: $375,000.

1901 Merrick Art Gallery, New Brighton, Pa. Cost: $20,000.

1902 Buffalo Historical Society, Buffalo, N. Y. Architect: George Cary, Buffalo. Cost: $175,000. Addition: 1929, $300,000.

1902 Fenway Court (now Isabella Stewart Gardner Museum), Boston, Mass. Residence designed for display of art collection. Opened as public museum 1924. Architect: Willard T. Sears.

1903 Berkshire Museum, Pittsfield, Mass. Architects: Harding and Seaver. Cost: $250,000. Remodeling and court addition: 1937, Morris and O'Connor, New York, N. Y., $250,000.

1903 Colorado Museum of Natural History (now Denver Museum of Natural History), Denver, Colo. First small unit, 1903, now central, and front unit, 1908, cost $108,000. Architects: Sterner and Williamson. Additions:

1919, north wing, $66,000; 1928, south wing, $85,000; 1940, rear auditorium, Roland L. Linder, Denver, $250,000; 1949, $90,000. Remodeling and new front unit projected to cost at least $350,000.

1903 Dyche Museum of Natural History, University of Kansas, Lawrence, Kan. Cost: $75,000. Remodeling: 1935, $35,000.

1903 Newport Historical Society, Newport, R. I. Architect: Jonas Bergner. Cost: $10,000. Addition: 1915, Joseph G. Stevens 2nd, $21,000.

1903 Semitic Museum, Harvard University, Cambridge, Mass. Architect: Alexander W. Longfellow. Cost: $80,000.

1904 Art Building, Louisiana Purchase Exposition, St. Louis, Mo. Architect: Cass Gilbert, New York, N. Y. Cost: $1,000,000. Reopened 1906 as St. Louis Museum (now City Art Museum), which see.

1905 Albright Art Gallery, Buffalo Fine Arts Academy, Buffalo, N. Y. Architect: Edward B. Green, Buffalo. Cost: $750,000.

1905 Barrow Art Gallery, Skaneateles, N. Y. Annex to Skaneateles Library.

1905 Gibbes Art Gallery, Carolina Art Association, Charleston, S. C.

1905 Holder Memorial, Clinton Historical Society, Clinton, Mass. Architect: Emil Greway. Cost: $83,000.

1905 *Museum of Art, Portland, Ore. Old building at 5th and Taylor Streets vacated 1931 and sold. Now occupied by Portland Chamber of Commerce. For present building see 1932.*

1905 Museum of Natural History, Colgate University, Hamilton, N. Y. Architect: William Gouge. Cost: $125,000.

1905 Pennsylvania State Museum, Harrisburg, Pa. Adapted Executive and State Library Building of 1894. Architect: John T. Windrim, Philadelphia.

1905 Whaling Museum, Nantucket Historical Association, Nantucket, Mass. Architect: George W. Watson. Cost: $50,000.

1906 Elgin Audubon Museum, Elgin, Ill.

1906 John Herron Art Institute, Art Association of Indianapolis, Indianapolis, Ind. Architects: Vonnegut and Bohn, Indianapolis. Cost: $182,000. Remodeling: 1941, Herbert Foltz and Son, Indianapolis, $70,000.

1906 St. Louis Museum (now City Art Museum), St. Louis, Mo. Same as Art Building 1904. For earlier building see 1881.

1906 Thoreau Museum, Middlesex School, Concord, Mass. Architects: Wheelwright and Haven. Cost: $7,000.

1907 Bucks County Historical Society, Doylestown, Pa. Architect: Horace Trumbauer. Cost: $18,000. Added: 1916, larger building, plans by Henry C. Mercer.

1907 John-Esther Art Gallery, Abbott Academy, Andover, Mass. Architects: Andrews, Jacques and Rantoul. Cost: $40,000.

1907 Susquehanna County Historical Society, Montrose, Pa. Architects: Cope and Stewardson, Philadelphia, Pa. Cost: $40,000.

1908 Albany Institute of History and Art, Albany, N. Y. Architects: Fuller and Robinson. Cost: $125,000.

1908 Aldrich Memorial, Portsmouth, N. H. Fireproof building beside historic house.

1908 Amherst College Science Museum, Amherst, Mass. Architects: McKim, Mead and White, New York, N. Y. Cost: $150,000. Now used also as a laboratory building.

1908 Edward Clark Hall, Department of Geology Museum, Williams College, Williamstown, Mass. Architect: Frank Wallace. Cost: $40,000.

1908 Everhart Museum of Natural History, Science and Art, Scranton, Pa. Architect: Blackwood. Cost: $80,000. Remodeling and addition: 1929, Morgan and Von Storch, Scranton, $280,000.

1908 Hispanic Society of America, New York, N. Y. Architect: Charles P. Huntington. Cost: $500,000.

1908 New York Historical Society, New York, N. Y. Architects: York and Sawyer, New York. Cost: $400,000. Remodeling and addition: 1939, Walker and Gillette, New York, $1,600,000.

1909 American Numismatic Society, New York, N. Y. Architects: Charles P. Huntington and H. B. Brooks Price. Cost: $350,000.

1909 Museum of Fine Arts, Boston, Mass. Architect: Guy Lowell, Boston. Cost: $1,600,000. Additions: 1915, Evans Wing, $1,000,000; 1928, Decorative Arts Wing, $600,000; 1931, completing Decorative Arts Wing, William T. Aldrich, Boston, $100,000; 1941, Karolik Wing, Henry and Richmond, Boston, $100,000. For earlier building see 1876.

1909 Pember Library and Museum, Granville, N. Y. Architect: Ashley Wilson, Middle Granville. Cost: $30,000.

1909 Walters Art Gallery, Baltimore, Md. Architects: Delano and Aldrich, New York, N. Y. Cost: $750,000.

1910 California State Exposition Building, Los Angeles, Calif.

1910 Gray Herbarium, Harvard University, Cambridge, Mass. Architect: William L. Mowll, Cambridge. Cost: $182,000. Addition: 1942, H. W. Andrews, $20,000.

1910 Historical Society of Pennsylvania, Philadelphia, Pa. Architect: Addison Hutton. Cost: $250,000.

1910 Morgan Memorial, Wadsworth Atheneum, Hartford, Conn. Architect: Benjamin Wistar Morris, New York, N. Y. Cost: $1,000,000, includes addition, 1916, and also Colt Wing, 1910, connecting Morgan Memorial with Wadsworth Atheneum, for which see 1844. For Avery Memorial see 1934.

1910 Smith Hall, Alabama Museum of Natural History, University of Alabama, Tuscaloosa, Ala.

1910 State Museum, Washington's Headquarters, Newburgh, N. Y. Building adjoining historic house. Architect: Franklin B. Ware. Cost: $25,000.

1911 Alumni Memorial Hall, Art Museum, University of Michigan, Ann Arbor, Mich. Architects: Donaldson and Meier, Detroit, Mich. Cost: $200,000.

1911 Fitchburg Historical Society, Fitchburg, Mass. Architects: H. M. Francis and Sons. Cost: $30,000.

1911 L. D. M. Sweat Memorial Art Museum, Portland Society of Art, Portland, Me. Architects: John Calvin Stevens and John Howard Stevens, Portland. Cost: $85,000.

1911 Mattatuck Historical Society, Waterbury, Conn.

1911 Toledo Museum of Art, Toledo, Ohio. Architects: Green and Wicks, Buffalo, N. Y. Cost: $250,000. Additions: 1926, Edward B. Green and Sons, Buffalo, $800,000; 1933, Edward B. Green and Son, $2,000,000.

1911 United States National Museum Natural History Building, Washington, D. C. Architects: Hornblower and Marshall, Washington, D. C. Cost: $3,500,000. For Arts and Industries Building see 1881.

1911 Vineland Historical and Antiquarian Society, Vineland, N. J. Architect: George E. Savage, Philadelphia, Pa. Cost: $11,000. Addition: 1931, $8,000.

1912 Hackley Gallery of Fine Arts, Muskegon, Mich. Architect: S. S. Beeman. Cost: $60,000.

1912 Isaac Delgado Museum of Art, New Orleans, La. Architects: Lebenbaum and Marx. Cost: $150,000.

1912 Letchworth Park Museum, Castile, N. Y. Cost: $5,000.

1912 Libby Museum, Wolfeboro, N. H. Frame building. Cost: $5,000.

1912 New England Historical and Genealogical Society, Boston, Mass. Architects: Brainerd, Leeds and Kellogg, Boston.

1912 New Hampshire Historical Society, Concord, N. H. Library building Architect: Guy Lowell, Boston, Mass. Cost: $600,000.

1913 Arnot Art Gallery, Elmira, N. Y. Remodeled residence. Cost of remodeling: $30,000.

1913 Greene Memorial Museum, Milwaukee-Downer College, Milwaukee, Wis. Architect: A. C. Eschweiler. Cost: $90,000.

1913 Historical Society of Western Pennsylvania, Pittsburgh, Pa. Architects: Ingham and Boyd, Pittsburgh. Cost: $25,000. Addition: 1931, $80,000.

1913 Jefferson Memorial, Missouri Historical Society, St. Louis, Mo. Architect: Isaac S. Taylor. Cost: $477,000.

1913 Los Angeles County Museum of History, Science and Art, Los Angeles, Calif. Architects: Hudson and Monell. Cost: $250,000. Additions: 1926, $1,000,000; 1929, $1,500,000, both by Allied Architects Association. Extensive remodeling and additions projected.

1914 Memorial Art Gallery, University of Rochester, Rochester, N. Y. Architects: Foster and Gade. Cost: $200,000. Addition: 1926, McKim, Mead and White, New York, N. Y., $250,000.

1914 Montclair Art Museum, Montclair Art Association, Montclair, N. J. Architect: Albert Randolph Ross. Cost: $75,000. Additions: 1924, William E. Moran, $85,000; 1931, Hobart B. Upjohn, New York, N. Y., $125,000.

1914 Ohio State Museum, Ohio State Archaeological and Historical Society, Columbus, Ohio. Architect: Joseph Nelson Bradford, Columbus. Cost: $100,000. Additions: 1926, $191,000; 1929, $164,000; under construction, Sims, Cornelius and Schooley, Columbus, about $1,000,000.

1914 Ontario County Historical Society, Canandaigua, N. Y. Architect: Claude Bragdon. Cost: $44,000.

1914 Southwest Museum, Los Angeles, Calif. Architects: Hunt and Burns, Los Angeles. Cost: $80,000. Addition: 1942, Gordon B. Kaufman, Arlington, Va., $51,000.

1915 Alfred O. Deshong Memorial Art Gallery, Chester, Pa. Architects:

Clarence W. Brazer and E. Donald Robb. Cost: $100,000.

1915 California Building, Panama-California Exposition, San Diego, Calif. Architect: Bertram G. Goodhue, New York, N. Y. Cost: $1,500,000. Occupied, with other buildings of California Quadrangle, by San Diego Museum 1916.

1915 Colorado State Museum, Denver, Colo. Remodeled courthouse. Cost: $460,000.

1915 Hayes Memorial, Fremont, Ohio. Building adjoining historic house. State Architect. Cost: $50,000. Addition: 1920, $50,000 (est.).

1915 Latter-Day Saints Church Museum, Salt Lake City, Utah. Cost: $35,000.

1915 Minneapolis Institute of Arts, Minneapolis Society of Fine Arts, Minneapolis, Minn. Architects: McKim, Mead and White, New York, N. Y. Cost: $524,000. Addition: 1927, $200,000.

1915 *Natural History Museum, San Diego Society of Natural History, San Diego, Calif. See item next following. For present building see 1933.*

1915 *Nevada Building, Panama-California Exposition, San Diego, Calif. Purchased and occupied by San Diego Society of Natural History 1915–1920, then sold. Foreign Arts Building, occupied by Society 1920–1922. Canadian Building, occupied by Society 1922–1932. Last two buildings used again, renamed, in California-Pacific International Exposition of 1935. For present building of Society see 1933.*

1915 Taylor Hall, Vassar College Art Gallery, Poughkeepsie, N. Y. Remodeled 1927. Architects of remodeling: Allen and Collens, John McAndrews, Theodore Mueller, Richard Bennett.

1916 Brooks Memorial Art Gallery, Memphis, Tenn. Architect: James Gamble Rogers, New York, N. Y. Cost: $114,000.

1916 California Academy of Science, San Francisco, Calif. West wing. Architect: Lewis P. Hobart, San Francisco. Cost: $192,000. Other units: addition, 1931, east wing with Simpson African Hall, $252,000; 1923, Steinart Aquarium, $263,000. Under construction: Simpson Annex, Morrison Planetarium, Morrison Auditorium, Lovell White Memorial Hall and Astronomy Hall; architects: Weihe, Frick and Kruse, San Francisco.

1916 Cleveland Museum of Art, Cleveland, Ohio. Architects: Hubbell and Benes, Cleveland; consultants: Edmund Wheelwright, Boston, Mass., and Henry W. Kent, New York, N. Y. Cost: $1,250,000.

1916 Medford Historical Society, Medford, Mass. Architect: Moses W. Mann. Cost: $5,000.

1916 New York State Museum, State Education Building, Albany, N. Y. Architects: Palmer and Hornbostel. Cost: $3,500,000. Museum has 2 upper (3rd and 4th) floors.

1916 Old Dartmouth Historical Society and Whaling Museum, New Bedford, Mass. Bourne Building, connecting with former bank remodeled 1906. Architect: Henry Vaughan. Cost. $100,000. Addition: Wood Building, 1935, $51,000.

1917 Dudley Peter Allen Memorial Museum of Art, Oberlin College, Oberlin, Ohio. Architect: Cass Gilbert, New York, N. Y. Cost: $203,000. Addition: 1938, Clarence Ward, Oberlin, $115,000.

1917 Museum of New Mexico, Santa Fe, N. Mex. Architect: Isaac H. Rapp. Cost: $65,000. See also 1931, Laboratory of Anthropology; and projected Museum of International Folk Art, Santa Fe.

1917 Thomas Welton Stanford Art Gallery, Stanford University, Palo Alto, Calif. Architects: Bakewell and Brown, San Francisco, Calif. Cost: $89,000.

1917 Washington State Historical Society (and Ferry Museum), Tacoma, Wash. Architects: G. W. Bullard and I. H. Hill. Cost: $78,000.

1918 Children's Art Centre, Boston, Mass. Architect: Alexander Morton Emerson, Boston. Cost: $17,000.

1918 Minnesota Historical Society, St. Paul, Minn. Architect: Clarence H. Johnston, St. Paul. Cost: $500,000.

1918 Public Museum, Staten Island Institute of Arts and Sciences, New York, N. Y. Architect: Robert W. Gardner, New York. Cost: $27,000. Additions: 1924, storage unit, $3,000; 1928, two upper floors, $30,000.

1919 Butler Art Institute, Youngstown, Ohio. Architects: McKim, Mead and White, New York, N. Y. Cost: $250,000. Addition: 1932, Paul Boucherle, Youngstown, $750,000.

1919 Maryland Historical Society, Baltimore, Md. Architect: William G. Nolting of Wyatt and Nolting, Baltimore. Cost: $160,000.

1920 *Buffalo Society of Natural Sciences, Buffalo, N. Y. First unit of projected building in Delaware Park Vacated for present building in Humboldt Park 1929.*

1920 Heckscher Park Art Museum, Huntington, Long Island, N. Y. Architect: J. Franke of Meynicke and Franke. Cost: $125,000.

1920 Howard Gardner Cushing Memorial Gallery, Art Association of Newport, Newport, R.I. Architects: Delano and Aldrich, New York, N. Y. Cost: $40,000.

1920 Knox Museum (science), Thomaston, Me. Plans by Norman W. Lermond, Thomaston. Cost: $3,000. Addition: 1929, $5,000.

1920 Upper Susquehanna Collection (archaeology), Hartwick College, Oneonta, N. Y. Cost $5,000.

1920 Woodstock Art Gallery, Woodstock, N. Y. Frame building. Architect: William A. Boring, New York, N. Y. Cost: $9,000.

1921 Battle Abbey, Confederate Memorial Institute (history), Richmond, Va. Architects: Bissell and Sinkler, Philadelphia, Pa. Cost: $160,000.

1921 Field Museum of Natural History (now Chicago Natural History Museum), Chicago, Ill. Architects: D. H. Burnham and Company; completed after Burnham's death by Graham, Anderson, Probst and White, Chicago. Cost: $7,000,000.

1921 Germanic Museum, Harvard University, Cambridge, Mass. Architect: G. Bestelmeyer, Munich, Germany. Cost: $247,205.

1921 Liberty Memorial Museum (history), Kansas City, Mo. Small building at monument. Architect: H. Van Buren Magonigle, New York, N. Y. Cost: $218,000.

1921 Lyme Art Association, Old Lyme, Conn. Frame building. Architect: Charles A. Platt, New York, N. Y.

Cost: $21,000. Addition: 1938, $5,000.

1921 Wilson Museum (science), Castine, Me. Architects: Milton, See and Son, New York, N. Y. Cost: $30,000.

1922 Art Galleries, American Academy of Arts and Letters, New York, N. Y. South building. Architect: William Mitchell Kendall of McKim, Mead and White, New York. For north building see 1930.

1922 Museum of Heads and Horns, New York Zoological Park, New York, N. Y. Architect: Henry D. Whitfield, New York. Cost: $146,000.

1922 Museum of the American Indian, New York, N. Y. Built in 1916. Architect: Charles P. Huntington, New York. Cost $250,000. For storage building see 1926.

1922 Santa Barbara Museum of Natural History, Santa Barbara, Calif. Architect: Floyd Brewster, Santa Barbara. Cost: $23,000. Additions: 1926, $15,000; 1927, $20,000; 1929, $18,000; 1933, $2,000; 1934, $29,000; architect (1926–34): Carlton Monroe Winslow, Los Angeles, Calif. Other additions: 1938, $50,000; 1939, $3,000; architect (1938–39): Chester J. Carjola, Santa Barbara.

1922 Vanderbilt Marine Museum (science), Huntington, Long Island, N. Y. Architects: Warren and Wetmore, New York, N. Y. Cost: $10,000. Addition: 1930, second story, $10,000.

1923 Freer Gallery of Art, Washington, D. C. Architect: Charles A. Platt, New York, N. Y. Cost: $1,125,000.

1923 Illinois State Museum, Centennial Building, Springfield, Ill. Architect: Edgar Martin of Schmidt, Garden and Martin, Chicago, Ill. Cost: $2,000,000. Museum occupies 2 upper floors.

1923 School Service Building, American Museum of Natural History, New York, N. Y. See American Museum 1877.

1924 American Wing, Metropolitan Museum of Art, New York, N. Y. See Metropolitan Museum 1880.

1924 California Palace of the Legion of Honor (art), San Francisco, Calif. Architect: George A. Applegarth, San Francisco. Cost: $900,000.

1924 Grand Rapids Art Gallery, Grand Rapids, Mich. Frame residence remodeled at cost of $50,000. Addition: 1929, Robinson Campau, $39,000.

1924 Laura Davidson Sears Academy of Fine Arts, Elgin Academy, Elgin, Ill. Architect: Harry F. Rich. Cost: $125,000.

1924 Museum of Fine Arts of Houston, Houston, Tex. Architects: William Ward Watkin, Houston, succeeding Ralph Adams Cram, deceased. Cost: $150,000. Addition: 1926, $150,000.

1924 State Historical Society of North Dakota, Bismarck, N. Dak. Architects: Kurke and Keith, Fargo, N. Dak. Cost: $415,000.

1925 Barnes Foundation, Merion, Pa. Architect: Paul P. Cret, Philadelphia, Pa. Cost: $350,000.

1925 Lauren Rogers Library and Museum of Art, Laurel, Miss. Museum is wing of library built 1923. Architect: Rathbone De Buys, New Orleans, La. Cost: $174,000.

1925 Mills College Art Gallery, Oakland, Calif. Architect: Walter H. Ratcliff, Berkeley, Calif. Cost: $86,000. Addition: 1931. Total cost: including classroom units, $137,000.

1925 Mulvane Art Museum, Washburn Municipal University, Topeka, Kan. Architect: Thomas Williamson, Wichita, Kan. Cost: $60,000.

1925 Museum (archaeology), Mesa Verde National Park, Colo. Architects: National Park Service. Cost: $5,000. Addition: 1936, $36,000.

1925 North Carolina State Museum, Raleigh, N. C. Annex to State Agriculture Building. Architect: H. A. Underwood. Cost: $125,000.

1925 Petersham Historical Society, Petersham, Mass. Architect: John S. Ames, Cambridge, Mass. Cost: $18,000.

1925 Radeke Building, Museum of Art, Rhode Island School of Design, Providence, R. I. Architect: William T. Aldrich, Boston, Mass. Cost: $500,000. Connecting with old building, for which see 1893.

1926 Canajoharie Art Museum, Canajoharie, N. Y. Annex to Canajoharie Library. Architects: Edward Lippincott Tilton and Alfred Morton Githens, New York, N. Y. Cost: $25,000.

1926 Fine Arts Gallery of San Diego, San Diego, Calif. Architects: William Templeton Johnson and Robert Snyder, San Diego. Cost: $410,000.

1926 Lawrence Art Museum, Williams College, Williamstown, Mass. Remodeled college library. Additions: 1926; 1938, $15,000.

1926 Middlesex County Historical Society, Middletown, N. Y. Addition to former residence. Architects: Towner and Sellew. Cost: $12,000.

1926 *Museum of Folk Arts, Riverdale, New York, N. Y. Converted into residence when collection was removed to New York Historical Society 1938.*

1926 Museum of the American Indian, New York, N. Y. Storage building in Bronx. Architect: Charles E. Birge. Cost: $300,000. For main building, in Manhattan, see 1922.

1926 Newark Museum (general), Newark, N. J. Architect: Jarvis Hunt, Chicago, Ill. Cost: $750,000.

1926 Peabody Museum of Natural History, Yale University, New Haven, Conn. Architects: Day and Klauder, Philadelphia, Pa. Cost: $750,000. For former building see 1876.

1926 Ticonderoga Museum, New York State Historical Association, Ticonderoga, N. Y. Architect: M. H. Westhoff, Enfield, Conn. Cost: $195,000. (Association headquarters at Cooperstown, N. Y.)

1926 Witte Memorial Museum (general), San Antonio, Tex. Architect: Robert M. Ayres, San Antonio. Cost: $150,000.

1926 Yosemite Museum (science, history), Yosemite National Park, Calif. Architect: Herbert F. Maier. Cost: $78,000.

1927 Arizona Museum (history), Phoenix, Ariz. Architects: Fitzhugh and Byron, Phoenix. Cost: $8,000.

1927 Detroit Institute of Arts, Detroit, Mich. Architects: Paul P. Cret, and Zantzinger, Borie, and Medary, Philadelphia, Pa. Cost: $4,000,000. For former building see 1888.

1927 Fogg Museum of Art, Harvard University, Cambridge, Mass. Architects: Coolidge, Shepley, Bulfinch and Abbott, Boston, Mass. Cost: $1,230,000. Addition: 1932, $81,000.

1927 H. C. Henry Art Gallery, University of Washington, Seattle, Wash.

Architects: Webb and Gould, Seattle. Cost: $100,000.

1927 Historical Museum, Louisiana State University, Baton Rouge, La. Architect: Theodore Link. Cost: $120,000.

1927 Honolulu Academy of Arts, Honolulu, Hawaii. Architect: Bertram G. Goodhue, New York, N. Y. Cost: $350,000.

1927 J. B. Speed Memorial Museum (now J. B. Speed Art Museum), Louisville, Ky. Architect: Arthur Loomis, Louisville. Cost: $536,000.

1927 Jasper Rand Art Museum, Westfield, Mass. Wing of Westfield Athenaeum. Architects: Coolidge and Carlson. Cost: $60,000.

1927 Nebraska State Museum, Morrill Hall, University of Nebraska, Lincoln, Nebr. Architects: Davis and Wilson, Lincoln. Cost: $356,000.

1927 Neville Public Museum (history), Green Bay, Wisc. Architects: Foeller, Schober and Stevenson; consulting architect: Francis Y. Joannes, New York, N. Y. Cost: $60,000.

1927 Walker Art Galleries (now Walker Art Center), Minneapolis, Minn. Architects: Long and Thorshov, Minneapolis. Cost: $600,000. Remodeled: 1944, Magney, Tussler and Setter, Minneapolis.

1927 William Pynchon Memorial Building, Connecticut Valley Historical Society, Springfield, Mass. Architect: Max H. Westhoff, Enfield, Conn. Cost: $119,000.

1927 York Institute (history), Saco, Me. Architects: John Calvin Stevens and John Howard Stevens, Portland, Me. Cost: $31,000.

1928 Bear Mountain Trailside Museum (science, history), Palisades Interstate Park, N. Y.-N. J. Zoology building. Architect: Herbert F. Maier. Cost: $11,000. Other buildings: 1933, geology, $16,000; 1934, originally botany, $13,000; 1934, history, $18,000.

1928 Cohen Memorial Art Museum, George Peabody College for Teachers, Nashville, Tenn. Architects: McKim, Mead and White, New York, N. Y. Cost: $200,000.

1928 *Cranbrook Academy of Art, Bloomfield Hills, Mich. Old museum building, now used for administration. For new museum-library see 1942.*

1928 Denver Art Museum, Denver, Colo. Frame residence (Chappell House) remodeled at cost of $50,000. Addition: 1931, auditorium, Burnham Hoyt, Denver, $50,000. For branch see Schleier Memorial 1949.

1928 Gallery of Fine Arts, Yale University (now Yale University Art Gallery), New Haven, Conn. Architect: Egerton Swartwout, New York, N. Y. Cost: $1,000,000. Projected addition by Philip L. Goodwin, New York. For early building see Trumbull Gallery 1832.

1928 *Highlands Museum and Biological Laboratory, Highlands, N. C. Annex to Hudson Public Library. Addition 1931. Taken over by library upon completion of new museum building 1941, which see.*

1928 Islesford Collection (history), Islesford, Me. Cost: $22,000.

1928 Mae Loomis Memorial Museum (science), Lassen Volcanic National Park, Calif. Cost: $25,000.

1928 Museum of Stone Age Antiquities, Acadia National Park, Me. Cost: $25,000.

1928 Philadelphia Museum of Art, Philadelphia, Pa. Associated architects: Horace Trumbauer, C. L. Borie, C. C. Zantzinger, Philadelphia. Cost: $13,850,000; interior construction (1936–49), $3,150,000. For early building see Memorial Hall 1876; for branch, Rodin Museum 1929.

1928 Reading Public Museum and Art Gallery, Reading, Pa. Architect: Alexander F. Smith, Reading. Cost: $480,000.

1928 University Museums, University of Michigan, Ann Arbor, Mich. Architects: Albert Kahn, Inc., Detroit, Mich. Cost: $900,000.

1928 Woolaroc Museum (history, science), Bartlesville, Okla. Cost: including additions, $200,000.

1928 Yavapai Point Observation Station (geology), Grand Canyon National Park, Ariz. Architect: Herbert F. Maier. Cost: $10,000.

1929 American Swedish Historical Museum, Philadelphia, Pa. Architect: John A. Nyden. Cost: $300,000.

1929 Baltimore Museum of Art, Baltimore, Md. Architects: John Russell Pope, New York, N. Y., and Howard Sill, Baltimore. Cost: $1,000,000. Additions: 1938, John Russell Pope, $525,000; unfinished wing, Young People's Art Center, Wrenn, Lewis and Jencks, Baltimore, $229,000; projected, Cone Wing, $400,000.

1929 Buffalo Museum of Science, Buffalo, N. Y. Architects: Esenwein and Johnson, Buffalo. Cost: $1,110,000. Addition projected since 1943: Rosewell E. Pfohl, Buffalo.

1929 Campus Martius State Memorial Museum, Marietta, Ohio. Architects: Briggs and Ridley, Columbus, Ohio. Cost: $48,000. Addition: 1932, $67,000.

1929 Children's Museum of Hartford, Hartford, Conn. Addition to former residence. Cost: $55,000. Second floor of addition being built.

1929 Currier Gallery of Art, Manchester, N. H. Architects: Edward Lippincott Tilton and Alfred Morton Githens, New York, N. Y. Cost: $365,000.

1929 Grant County Historical Society, Marion, Ind. Cost: $10,000.

1929 Heard Museum (art), Phoenix, Ariz. Architect: H. H. Green of Green and Hall, Phoenix. Cost: $63,000.

1929 Historical Society of Berks County, Reading, Pa. Architects: Muhlenberg Brothers, Reading. Cost: $99,000.

1929 Indian Museum, Wayside Museums, Harvard, Mass. Remodeled schoolhouse. Cost: $10,000. Addition: 1932, $3,000. For Wayside Museums see also 1940.

1929 Junipero Serra Museum (history), San Diego, Calif. Architect: William Templeton Johnson, San Diego, Cost: $90,000.

1929 Laguna Beach Art Gallery, Laguna Beach, Calif. Architects: Myron Hunt and H. C. Chambers, Los Angeles, Calif. Cost: $20,000.

1929 Lynn Historical Society, Lynn, Mass. Addition to historic house. Architect: W. T. Aldrich, Boston, Mass. Cost: $35,000.

1929 Museum (archaeology), Cahokia Mound State Park, Ill. Architects: Division of Architecture and Engineering, State Department of Public Works and Buildings. Cost: $15,000.

1929 New Jersey State Museum, Trenton, N. J. West wing of State House Annex. Architects: J. Osborne Hunt and Hugh Kelly. Cost: $600,000. Museum occupies ground floor and part of basement.

1929 Old Faithful Museum (geology), Yellowstone National Park, Wyo. Architect: Herbert F. Maier. Cost: $30,000.

1929 Phillips County Museum (general), Helena, Ark. Annex to Helena Public Library. Architect: Andrew Pomeroy Coolidge, Helena. Cost: $12,000.

1929 Rodin Museum, Philadelphia, Pa. Branch of Philadelphia Museum of Art. Architects: Paul P. Cret, Philadelphia, and Jacques Gréber, Paris. Cost: $242,000. For Philadelphia Museum of Art see 1928.

1929 Senate House Museum, Kingston, N. Y. Supplementary building of historic house museum. Cost: $70,000.

1929 Theodore Lyman Wright Art Hall, Beloit College, Beloit, Wis. Architects: Berlin and Swern, Chicago, Ill. Cost: $145,000.

1930 Adler Planetarium and Astronomical Museum, Chicago, Ill. Architect: Ernest A. Grunsfeld, Jr., Chicago. Cost: $485,000.

1930 Art Galleries, American Academy of Arts and Letters, New York, N. Y. North building. Architect: Cass Gilbert, New York. Cost: $350,000. For south building see 1922.

1930 Art Gallery, Haish Memorial Library, De Kalb, Ill. Wing of library building. Architects: White and Weber.

1930 Baker-Hunt Foundation Museum (science), Covington, Ky. Architects: Garber and Woodward, Cincinnati, Ohio. Cost: $32,000.

1930 Concord Antiquarian Society, Concord, Mass. Architect: Harry B. Little, Boston, Mass. Cost: $65,000.

1930 *Cranbrook Institute of Science, Bloomfield Hills, Mich. Architect: Robert Kelly. Cost: $65,000. Later demolished except for observatory unit incorporated in new building 1938, which see.*

1930 Danvers Historical Society, Danvers, Mass. Architect: Lester Couch, Danvers. Cost: $23,000.

1930 Dayton Art Institute, Dayton, Ohio. Architect: Edward B. Green, Buffalo, N. Y. Cost: $1,294,000.

1930 Fairfield Historical Society, Fairfield, Conn. Annex to Fairfield Memorial Library. Architect: Norman M. Isham. Cost: $40,000.

1930 Faulkner Memorial Art Gallery, Santa Barbara, Calif. Annex to Santa Barbara Public Library. Architects: Myron Hunt and H. C. Chambers, Los Angeles, Calif. Cost: $65,000. Now used as art reading room and gallery.

1930 Historical Society of Frankford, Philadelphia, Pa. Architect: Frank R. Watson, Philadelphia. Cost: $50,000.

1930 Houston Museum of Natural History, Houston, Tex. Frame building. Architect: J. A. McVey. Cost: $10,000.

1930 John Woodman Higgins Armory, Worcester, Mass. Third and fourth floors of Worcester Pressed Steel Company building. Architect: Joseph D. Leland of Leland and Larsen, Boston, Mass. Cost: $320,000.

1930 Madison Trailside Museum (history), Yellowstone National Park, Wyo. Architect: Herbert F. Maier. Cost: $20,000.

1930 Museum (science), Rocky Mountain National Park, Colo. Architects: National Park Service. Cost: $7,000.

1930 Museum of the City of New York, New York, N. Y. Architect: Joseph Freedlander, New York. Cost: $1,700,000.

1930 Museums of Biology and Geology, University of Rochester, Rochester, N. Y. Wing of Chester Dewey Building. Architects: Gordon and Kaelber, Rochester. Cost of building: $450,000.

1930 Norris Trailside Museum (geology), Yellowstone National Park, Wyo. Architect: Herbert F. Maier. Cost: $30,000.

1930 Oklahoma Historical Society, Oklahoma City, Okla. Architects: Layton, Hicks and Forsyth, Oklahoma City. Cost: $500,000.

1930 Regar Memorial Museum of Natural History, Anniston, Ala. Annex to Carnegie Library. Architect: Frank Lockwood. Cost: $35,000.

1931 Adams Memorial Hall (history), Deadwood, S. Dak. Architect: R. L. Ewing. Cost: $74,000.

1931 Addison Gallery of American Art, Phillips Academy, Andover, Mass. Architect: Charles A. Platt, New York, N. Y. Cost: $450,000.

1931 Art Gallery, Winchester Art Association, Winchester, Mass. Wing of Winchester Public Library. Architect: Robert Coit, Boston, Mass.

1931 Columbus Gallery of Fine Arts, Columbus, Ohio. Architect: Wilfred A. Paine of Richards, McCarthy and Bulford, Columbus. Cost: $486,000.

1931 Guild Hall Galleries, East Hampton, Long Island, N. Y. Architect: Aymar Embury, New York, N. Y. Cost: $120,000.

1931 James Henry Breasted Hall, Oriental Institute, University of Chicago, Chicago, Ill. Architects: Mayers, Murray and Phillips, New York, N. Y. Cost: $703,000. For former building see 1896.

1931 Joslyn Memorial Art Museum, Omaha, Nebr. Architects: John McDonald and Alan McDonald, Omaha. Cost: $2,371,000.

1931 Laboratory of Anthropology, Museum of New Mexico, Santa Fe, N. Mex. Architect: John Gaw Meem, Santa Fe. Cost: $272,000. For Museum of New Mexico see 1917.

1931 Lake Trailside Museum (science), Yellowstone National Park, Wyo. Architect: Herbert F. Maier. Cost: $30,000.

1931 Monmouth County Historical Society, Freehold, N. J. Architects: W. H. and J. H. Conover. Cost: $40,000.

1931 Museum (archaeology), Casa Grande National Monument, Ariz. Architects: National Park Service. Cost: $10,000.

1931 Mystic Art Association, Mystic, Conn. Architects: Jackson, Robertson and Adams, Providence, R. I., and George Fraser. Cost: $20,000.

1931 New English Memorial, New Haven Colony Historical Society, New Haven, Conn. Architect: J. Frederick Kelly, New Haven. Cost: $350,000. For former building see 1893.

1931 New Jersey Historical Society, Newark, N. J. Architects: John H. and Wilson C. Ely, Newark. Cost: $311,000.

1931 Parthenon Art Gallery, Nashville, Tenn.

1931 Robert Hull Fleming Museum, University of Vermont, Burlington, Vt. Architects: McKim, Mead and White, New York, N. Y. Cost: $272,000.

1931 San Joaquin Pioneer Museum and Haggin Art Galleries, Stockton, Calif. Architect: W. J. Wright, Stockton. Cost: $100,000. Additions: 1939, Lewis P. Hobart, San Francisco, Calif., $38,000; 1949, Howard G. Bissell, Stockton, $200,000.

1931 Sinnott Memorial (geology), Crater Lake National Park, Ore. Architects: National Park Service. Cost: $10,000.

1931 Suffolk County Historical Society, Riverhead, Long Island, N. Y. Architect: August Galow, Huntington, Long Island. Cost: $53,000.

1931 Sylvia Bradley Memorial (history), Southington, Conn. Annex to Southington Public Library. Architect: Walter P. Crabtree, Hartford, Conn. Cost: $16,000.

1931 Washington County Museum of Fine Arts, Hagerstown, Md. Architects: Hyde and Shepherd, New York, N. Y. Cost: $115,000. Additions: 1949, William Edgar Shepherd, Washington, D. C., $175,000.

1931 Whitney Museum of American Art, New York, N. Y. Three adjoining residences remodeled at cost of $500,000. Architects of remodeling: Noel and Miller, New York. Building on another site projected.

1932 Blanden Memorial (art), Fort Dodge, Iowa. Architect: E. D. Damon, Fort Dodge. Cost: $40,000.

1932 Chicago Historical Society, Chicago, Ill. Architects: Graham, Anderson, Probst and White, Chicago. Cost: $1,000,000. For former building see 1896.

1932 Elmer Reynolds Memorial Museum (science), Silver Lake, Calif. Architect: Joseph Losekam, Stockton, Calif. Cost: $2,800.

1932 Golf Museum, James River Golf and Country Club, Newport News, Va. Wing of clubhouse. Cost: $25,000.

1932 John and Mable Ringling Museum of Art, Sarasota, Fla. Architect: J. H. Phillips, New York, N. Y. Cost: $4,000,000.

1932 Kingman Memorial Museum of Natural History, Battle Creek, Mich. Architect: A. B. Chenel, Battle Creek. Cost: $100,000.

1932 Lyman Allyn Museum (art), New London, Conn. Architect: Charles A. Platt, New York, N. Y. Cost: $306,000. Addition: 1939, James H. Allyn, Mystic, Conn., $40,000.

1932 Manchester Historic Association, Manchester, N. H. Architects: Edward Lippincott Tilton and Alfred Morton Githens, New York, N. Y. Cost: $75,000.

1932 Miami County Historical Society, Peru, Ind. Architect: Arthur Church, Churubusco, Ind. Cost: $12,000.

1932 Museum of Art, Portland Art Association, Portland, Ore. Architect: Pietro Belluschi of A. E. Doyle and Associates, Portland. Cost: $150,000. Addition: Hirsch Wing, 1939, $212,000. For former building see 1905.

1932 Museum of Art, University of Oregon, Eugene, Ore. Architects: Lawrence, Holford, Allyn and Bean, Portland, Ore. Cost: $200,000.

1932 New London Public Museum (history, science), New London, Wis. Architect: Victor Thomas, New London. Cost: $20,000.

1932 Norfolk Museum of Arts and Sciences, Norfolk, Va. Architects: Peebles and Ferguson, and Calrow, Browne and Fitz-Gibbon, Norfolk. Cost: $125,000. Addition: 1939, T. David Fitz-Gibbon and Clarence A. Neff, Norfolk, $100,000.

1932 Pacific Grove Museum (science), Pacific Grove, Calif. Remodeled residence with addition costing $14,000.

1932 Rosicrucian Egyptian Oriental Museum, San Jose, Calif. Cost: $11,000. Additions: several, including wing 1938, $29,000. For Rosicrucian Planetarium see 1936.

1932 Seattle Art Museum, Seattle, Wash. Architect: Carl F. Gould of Bebb and Gould, Seattle. Cost: $250,000. Addition: 1947, $40,000.

1932 Somerville Historical Society, Somerville, Mass. Architect: William A. Dykeman, Boston, Mass. Cost: $36,000.

1932 Wayside Museum (archaeology), Grand Canyon National Park, Ariz. Architects: National Park Service. Cost: $5,000.

1933 Art Barn, Salt Lake City, Utah. Frame building. Cost: $17,000.

1933 Edison Institute (history), Dearborn, Mich. Architect: Robert O. Derrick, Detroit, Mich. Cost: $5,000,000.

1933 Franklin Institute (science and industry), Philadelphia, Pa. Architect: J. T. Windrim, Philadelphia. Cost: $3,530,000. Includes Benjamin Franklin Memorial and Fels Planetarium.

1933 Mariners' Museum (history), Newport News, Va. Cost: $140,000. Additions: 1936, $50,000; 1941, $48,000.

1933 Museum (geology, archaeology), Petrified Forest National Monument, Ariz. Architects: National Park Service. Cost: $13,000.

1933 Museum of Science and Industry, Chicago, Ill. Reconstruction, with interior remodeling, of Art Palace, fine arts building of World's Columbian Exposition, 1893, architect Charles B. Attwood. Architects of reconstruction: Graham, Anderson, Probst and White, Chicago; architects of new interior: Shaw, Naess and Murphy, Chicago. Cost: including work done after opening, $8,000,000.

1933 Nantucket Maria Mitchell Association, Nantucket, Mass. Addition to historic house. Cost: $11,000.

1933 Natural History Museum, San Diego Society of Natural History, San Diego, Calif. Architect: William Templeton Johnson, San Diego. Cost: $130,000. For former building see 1915.

1933 Panhandle-Plains Historical Society, Canyon, Tex. Architects: Carder and Rittenbury, Amarillo, Tex. Cost: $55,000. Addition: 1936, $21,000.

1933 Springfield Museum of Fine Arts, Springfield, Mass. Architects: Edward Lippincott Tilton and Alfred Morton Githens, New York, N. Y. Cost: $300,000.

1933 William Rockhill Nelson Gallery of Art (and Atkins Museum of Fine Arts), Kansas City, Mo. Architects: Wight and Wight, Kansas City. Cost: $3,150,000.

1934 Avery Memorial (art), Wadsworth Atheneum, Hartford, Conn. Architects: Morris and O'Connor, New York, N. Y. Cost: $608,000. For other buildings of Wadsworth Atheneum see 1844 and 1910.

1934 Camp Museums (science), Palisades Interstate Park, N. Y.-N. J. Five small buildings, at Lakes Tiorate, Stanahe, and Kanawauke, and Cohasset Lake and Twin Lakes.

1934 Drake Well Memorial Museum (history), Titusville, Pa. Architect: H. Crosby, Oil City, Pa. Cost: $10,000.

1934 Fitchburg Art Association, Fitchburg, Mass. Former stable rebuilt, after fire, at cost of $27,000.

1934 Henry E. Huntington Library and Art Gallery, San Marino, Calif. Gallery is wing of former residence. Architects of wing: Myron Hunt and H. C. Chambers, Los Angeles, Calif. Cost: $110,000.

1934 Museum of Northern Arizona (art, science), Flagstaff, Ariz. Cost: $6,000. Addition: 1936, $25,000.

1934 Ste. Genevieve Museum (history), Ste. Genevieve, Mo. Cost: $5,000.

1935 Charles W. Bowers Memorial Museum (history), Santa Ana, Calif. Architects: W. H. Austin and F. Lansdown, Santa Ana. Cost: $65,000.

1935 Con Foster Museum (history), Traverse City, Mich. Architects: Giffels and Vallet, Detroit. Cost: $40,000.

1935 Frick Collection, The (art), New York, N. Y. Former residence, partly remodeled with additions at cost of $1,500,000. Architect of remodeling: John Russell Pope, New York. Added storage structure: 1942, Eggers and Higgins, New York, $175,000.

1935 Griffith Observatory (planetarium), Los Angeles, Calif. Architects: John C. Austin and Frederick M. Ashley, Los Angeles. Cost: $321,000.

1935 Hayden Planetarium, New York, N. Y. See American Museum of Natural History 1877.

1935 Museum (science), Boulder Dam State Park, Overton, Nev. Architects: Civilian Conservation Corps. Cost: $10,000.

1935 Museum (history), Chickamauga-Chattanooga National Military Park, Chattanooga, Tenn. Architects: National Park Service. Central part of administration building costing $55,000.

1935 Nature Museum, Peoples Forest, Barkhamsted, Conn. Cost: $5,000.

1935 Pioneer Museum, Blue Licks Battlefield State Park, Ky. Architects: Frankle and Curtis. Cost: $14,000.

1935 San Francisco Museum of Art, War Memorial, San Francisco, Calif. Architect: Arthur Brown, Jr., San Francisco. Museum occupies upper (4th) floor and part of basement. Cost: total, $3,000,000; museum share, about $1,000,000.

1935 Thomas H. Bayly Memorial Museum of Fine Arts, University of Virginia, Charlottesville, Va. Architect: Edmund S. Campbell, Charlottesville. Cost: $145,000.

1935 Whitney Memorial (South Oceanic Wing), American Museum of Natural History, New York, N. Y. Also African Wing and other 1935 additions. See American Museum 1877.

1935 Wichita Art Museum, Wichita, Kan. Architect: Clarence S. Stein, New York, N. Y. Cost: $90,000.

1936 Arizona State Museum, Tucson, Ariz. Architect: Roy Place, Tucson. Cost: $80,000.

1936 Army Aeronautical Museum, Dayton, Ohio. Architects: Pretzinger and Pretzinger, Dayton. Cost: $255,000.

1936 Boise Gallery of Art, Boise, Idaho. Architect: James A. Fennel of Wayland and Fennel, Boise. Cost: $21,000.

1936 Colorado Springs Fine Arts Center, Colorado Springs, Colo. Architect: John Gaw Meem, Santa Fe, N. Mex. Cost: $517,000.

1936 Dallas Museum of Fine Arts, Dallas, Tex. Architects: De Witt and Washburn; H. M. Greene, La Roche and Dahl; Ralph Bryan; Henry Coke Knight, all of Dallas; consulting architect: Paul P. Cret, Philadelphia, Pa. Cost: $424,000.

1936 Dallas Museum of Natural History, Dallas, Tex. Architects: Mark Lemmon, Clyde H. Griesenbeck and John B. Danna; and Frank Keen, Dallas. Cost: $248,000.

1936 Domestic Arts Building, Texas Centennial Exposition, Dallas, Tex. Architect: J. A. Pitzinger, Dallas. Cost: $89,000. Remodeled for Dallas Health Museum 1946.

1936 Fine Arts Building, State University of Iowa, Iowa City, Iowa. Architect: George L. Horner, Iowa City. Cost: $226,000.

1936 Hall of State, Texas Centennial Exposition, Dallas, Tex. Architect: Walter C. Sharp, Dallas. Cost: $1,200,000. Occupied by Dallas Historical Society 1938.

1936 Mint Museum of Art, Charlotte, N. C. Building of U. S. Branch Mint (1835, William Strickland, architect) moved to new site, rebuilt and remodeled by Works Progress Administration at cost of $75,000.

1936 Museum (archaeology), Aztec Ruins National Monument, N. Mex. Architects: National Park Service. Cost: $10,000.

1936 Museum (history), Black Hawk State Park, Rock Island, Ill. Cost: $10,000.

1936 Museum (science), Custer State Park, Hermosa, S. Dak. Architects: Cecil Doty and Arthur Temple. Cost: $32,000.

1936 Museum (science), Devils Tower National Monument, Wyo. Architects: National Park Service. Cost: $11,000.

1936 Museum (history), Shiloh National Military Park, Tenn. Architects: National Park Service. Wing of administration building, partly remodeled. Cost: $14,000.

1936 Museum (history), Stony Point Battlefield State Reservation, Stony Point, N. Y. Architects: Works Progress Administration. Cost: $65,000.

1936 Oregon Trail Museum (history), Scotts Bluff National Monument, Nebr. Architects: National Park Service. Cost: $10,000. Additions: 1937, $19,000; 1949, $10,000.

1936 Roosevelt Memorial, American Museum of Natural History, New York, N. Y. See American Museum 1877.

1936 Rosicrucian Planetarium, San Jose, Calif. Cost: $75,000. For Rosicrucian Egyptian Oriental Museum see 1932.

1936 Sharlot Hall Museum (history), Prescott, Ariz. Cost: $15,000.

1936 Virginia Museum of Fine Arts, Richmond, Va. Architects: Peebles and Ferguson, Norfolk, Va. Cost: $270,000. Addition projected: architect: Merrill C. Lee, Richmond; consulting architects: Eggers and Higgins, New York, N. Y.

1937 Alms Wing, Cincinnati Art Museum,

Cincinnati, Ohio. See Cincinnati Art Museum 1881.

1937 Art Museum, New Britain Institute, New Britain, Conn. Remodeled former residence. Addition being built. Architect, Delbert K. Perry, New Britain. Cost: $80,000.

1937 Audubon Museum (history), Henderson Audubon Memorial State Park, Henderson, Ky. Architects: Works Progress Administration. Cost: $55,000.

1937 Big Bend Historical Memorial, West Texas Historical and Scientific Society, Alpine, Tex. Architect: V. J. Smith, Alpine. Cost: $50,000.

1937 Children's Museum, Boston, Mass. Annex to former residence. Cost: $50,000.

1937 Historical Museum, Morristown National Historical Park, Morristown, N. J. Architects: National Park Service. Cost: $139,000.

1937 Logan County Museum, Historical and Natural History Society of Logan County, Sterling, Colo. Architects: Works Progress Administration. Cost: $11,000.

1937 Museum (history), Guilford Courthouse National Military Park, N. C. Architects: National Park Service. Central part of museum and administration building costing $29,000.

1937 Museum (science), Indian Springs State Park, Jackson, Ga. Cost: $9,000.

1937 Museum (archaeology), Tuzigoot National Monument, Ariz. Architects: National Park Service. Cost: $10,000.

1937 Museum of Fine Arts, Little Rock, Ark. Architect: H. Ray Burks, Little Rock. Cost: $70,000.

1937 Museums (science), University of New Mexico, Albuquerque, N. Mex. Part of administration building. Architect: John Gaw Meem, Santa Fe, N. Mex.

1937 Roswell Museum, Chaves County Archaeological and Historical Society, Roswell, N. Mex. Architects: Works Progress Administration. Cost: $9,000. Addition: 1949, Vorhees and Standhardt, Roswell, $10,000.

1937 Springville High School Art Gallery, Springville, Utah. Architects: Works Progress Administration. Cost: $111,000.

1937 University of Colorado Museum (science), Boulder, Colo. Architect: Charles Z. Klauder, Philadelphia, Pa. Cost: $150,000.

1937 Wachovia Historical Society, Winston-Salem, N. C. Hall of History, exhibition building. Architect: Hall Crews, Winston-Salem. Cost: $32,000.

1938 Cloisters, The, New York, N. Y. Branch of Metropolitan Museum of Art. Architect: Charles Collens of Allen, Collens and Willis, Boston, Mass. Cost: $2,500,000.

1938 Cranbrook Institute of Science, Bloomfield Hills, Mich. Architect: Eliel Saarinen, Bloomfield Hills. Cost: $238,000. Incorporates remaining part of earlier building, see 1930.

1938 Dallas Historical Society, Dallas, Tex. Same as Hall of State, 1936, which see.

1938 Delaware Art Center, Wilmington, Del. Architects: Victorine and Samuel Homsey, and G. Morris Whiteside, Wilmington. Cost: $243,000.

1938 Museum (geology), Ginko State Park, Quincy, Wash. Architects: Civilian Conservation Corps. Cost: $20,000.

1938 Museum (history), Sacajawea State Park, Wash. Architect: E. E. McCannell, State Parks Committee, Olympia, Wash. Cost: $28,000.

1938 Museum (history), Tumacacori National Monument, Ariz. Architects: National Park Service. Cost: $29,000.

1938 Museum of Navajo Ceremonial Art, Santa Fe, N. Mex. Architect: William P. Henderson, Santa Fe. Cost: $70,000.

1938 National Baseball Hall of Fame and Museum, Cooperstown, N. Y. Architect: Frank Whiting, Greenwich, Conn. Cost. $52,000. Addition projected: Harry St. Clair Zogbaum, Cooperstown.

1938 Osage Indian Museum, Pawhuska, Okla. Architects: Works Progress Administration. Cost: $26,000.

1938 Rapid City Indian Museum, Rapid City, S. Dak. Architect: W. J. W. Winter, Works Progress Administration. Cost: $30,000.

1938 Science Museum, St. Paul Institute, St. Paul, Minn. Auditorium addition to former residence. Architects: Ellerbe and Company, St. Paul. Cost: $38,000.

1938 Society of the Four Arts, Palm Beach, Fla. Architect: Maurice Fatio of Treanor and Fatio, New York and Palm Beach. Cost: $45,000.

1938 Texas Memorial Museum (history, science), Austin, Tex. Architect: John Staub, Houston, Tex. Cost: $392,000.

1938 Toledo Museum of Science, Toledo, Ohio. Architects: Paul S. Robinette followed by Michael B. O'Shea. Cost: $900,000.

1938 Will Rogers Memorial Museum (history), Claremore, Okla. Architect: John Duncan Forsyth, Tulsa, Okla. Cost: $200,000.

1939 Allerton Wing, Art Institute of Chicago, Chicago, Ill. See Art Institute 1893.

1939 Art Gallery, University of Southern California, Los Angeles, Calif. Architect: Ralph C. Flewelling, Los Angeles. Cost: $50,000.

1939 Buhl Planetarium and Institute of Popular Science, Pittsburgh, Pa. Architects: Ingham and Boyd, Pittsburgh. Cost: $1,070,000.

1939 Burpee Art Gallery, Rockford, Ill. Remodeled stone residence with gallery addition. Architect: A. Reynar Eastman, Rockford. Cost of gallery: $35,000.

1939 Door County Historical Society, Sturgeon Bay, Wisc. Architect: William J. Bernhard, Ephraim, Wisc. Cost: $23,000.

1939 Hastings Museum (general), Hastings, Nebr. Architect: Kenneth H. Gedney, Hastings. Cost: $96,000.

1939 Kentucky Museum, Western Kentucky State Teachers College, Bowling Green, Ky. Architect: Brinton B. Davis, Louisville, Ky. Cost: $207,000.

1939 Mary Buie Museum (art), Oxford, Miss. Architects: Stevens and Johnston, Starkville, Miss. Cost: $30,000.

1939 Museum (history), Fort Lincoln State Park, N. Dak. Architect: Arthur Cayou, Bismarck, N. Dak. Cost: $75,000.

1939 Museum (science), Guernsey Lake Park, Wyo. Built in 1936. Architect: Herbert F. Maier. Cost: $26,000.

1939 Museum (archaeology), Mound State

Park, Moundville, Ala. Architects: Civilian Conservation Corps. Cost: $35,000.

1939 Museum of Modern Art, New York, N. Y. Architects: Philip L. Goodwin; associate, Edward D. Stone; New York. Cost: $1,350,000.

1939 San Jacinto Museum of History, San Jacinto Monument, Tex. Museum forms base of shaft. Architect: Alfred C. Finn, Houston, Tex. Total cost: $1,240,000.

1939 Santa Rosa Junior College Museum, Santa Rosa, Calif. Architect: C. A. Caulkins, Jr., Santa Rosa. Cost: $40,000.

1939 State Exhibit Building, Shreveport, La. Architects: Neild, Samdal and Neild, Shreveport. Cost: $536,000.

1939 U. S. Naval Academy Museum, Annapolis, Md. Architect: F. W. Southworth, Bureau of Yards and Docks, Navy Department, Washington, D. C. Cost: $175,000.

1939 World War Memorial (history), St. Louis, Mo. Architects: Mauran, Russell, Crowell and Mullgardt, St. Louis. Cost: $716,000.

1940 Beal-Maltbie Shell Museum, Rollins College, Winter Park, Fla. Architect: Harold Hair, Winter Park. Cost: $23,000.

1940 Dumbarton Oaks Research Library and Collection (art), Washington, D. C. Architect: Thomas T. Waterman, Washington. Cost: $250,000 (est.)

1940 Franklin D. Roosevelt Library, Hyde Park, N. Y. Includes museum. Architect: Louis A. Simon, Federal Works Agency, Washington, D. C. Cost: $350,000.

1940 Gallery of Primitive Paintings, Wayside Museums, Harvard, Mass. Architect: George H. Hayter, Clinton, Mass. Cost: $10,000. For Wayside Museums see also 1929.

1940 Grand Rapids Public Museum (science), Grand Rapids, Mich. Architect: Roger Allen, Grand Rapids. Cost: $263,000. Addition projected to cost $750,000.

1940 Minnesota Museum of Natural History, University of Minnesota, Minneapolis, Minn. Architect: C. H. Johnson, Minneapolis. Cost: $272,000.

1940 Museum (archaeology), Ocmulgee National Monument, Macon, Ga. Architects: National Park Service. Cost: $219,000. Addition being built to cost $135,000.

1940 Museum (science), White Sands National Monument, N. Mex. Architects: National Park Service. Cost: $27,000.

1940 Ochs Memorial Observatory and Museum, Chickamauga-Chattanooga National Military Park, Chattanooga, Tenn. Architects: National Park Service. Cost: $15,000.

1940 Roosevelt County Museum (general), Portales, N. Mex. Architect: R. E. Merrill, Clovis, N. Mex. Cost: $18,000.

1940 State Department of Archives and History, Montgomery, Ala. Architects: Warren, Knight and Davis, Birmingham, Ala. Cost: $500,000.

1941 Allan Hancock Foundation, University of Southern California, Los Angeles, Calif. Research laboratory and museum. Architect: Charles Raimond Johnson; consultant, Samuel E. Lunden, Los Angeles. Cost: $1,000,000.

1941 Art Gallery, Lake Worth, Fla. Wing

of Lake Worth Public Library. Architect: Edgar Wortman, Lake Worth. Cost: $10,000.

1941 Fisher Museum (science), Harvard Forest, Petersham, Mass. Plans by H. W. Andrews. Cost: $25,000.

1941 High Museum of Art, Atlanta, Ga. Addition to remodeled residence. Architects: Cooper and Cooper, Atlanta. Cost of addition: $10,000.

1941 Highlands Museum of Natural History, Highlands, N. C. Architect: Alfred Kastner, Washington, D. C. Cost: $21,000.

1941 Landis Valley Museum (history), Lancaster, Pa. Architect: Charles Henry Muhlenberg, Jr., Reading, Pa. Cost: $41,000.

1941 Museum of the Plains Indian, Browning, Mont. Architect: Carl Cederstrand, U. S. Office of Indian Affairs. Cost: $110,000.

1941 National Gallery of Art, Washington, D. C. Architect: John Russell Pope; associates, Otto R. Eggers and Daniel Paul Higgins, New York, N. Y. Cost: $16,057,000.

1941 Norton Gallery and School of Art, West Palm Beach, Fla. Architects: Wyeth and King, Palm Beach. Cost: $290,000.

1941 Palo Alto Junior Museum, Palo Alto, Calif. Architect: Dole Ford Thomson, Palo Alto. Cost: $10,000. Addition: 1943, $12,000.

1941 Philbrook Art Museum, Tulsa, Okla. Auditorium addition to former residence. Cost: $50,000.

1942 Allen County Historical Society, Lima, Ohio. Basement of projected building. Cost: $6,000.

1942 Morse Gallery of Art, Rollins College, Winter Park, Fla.

1942 Cranbrook Academy of Art, Museum-Library Building, Bloomfield Hills, Mich. Architect: Eliel Saarinen, Bloomfield Hills. Cost: $477,000.

1942 Museum (history), Kings Mountain National Military Park, S. C. Architects: National Park Service. Cost: $31,000.

1942 Rochester Museum of Arts and Sciences, Rochester, N. Y. Architects: Kaelber and Waasdorp, and John Wenrich, Rochester. Cost: $559,000. Auditorium addition projected.

1942 Whaling Museum (history), Cold Spring Harbor, Long Island, N. Y. Architect: Edward S. Hewitt, New York, N. Y. Cost: $3,000.

1943 Museum of Geology, South Dakota School of Mines and Technology, Rapid City, S. Dak. Museum and library building. Architect: James Ewing, Rapid City. Cost: $211,000. Museum has top (2nd) floor.

1946 Dallas Health Museum, Dallas, Tex. Remodeled exposition building, Domestic Arts Building 1936, which see.

1948 Des Moines Art Center, Des Moines, Iowa. Architects: Saarinen, Swanson and Saarinen, Birmingham, Mich., and Brooks-Borg, Des Moines. Cost: $700,000.

1948 Southern Plains Indians Museum, Anadarko, Okla. Architect: Carl Cedarstrand, U. S. Office of Indian Affairs. Cost: $50,000.

1948 Utah Field House of Natural History, Vernal, Utah. Architect: Miles E. Miller, Salt Lake City, Utah. Cost: $198,000.

1948 William A. Farnsworth Art Museum, Rockland, Me. Architects: Wadsworth, Boston and Tuttle, Portland, Me.; resident architect; Boyd Livesay, Rockland; architectural advisor, Robert P. Bellows, Boston, Mass. Cost: $600,000.

1949 Children's Museum of Indianapolis, Indianapolis, Ind. Addition to former residence. Cost of addition: $35,000.

1949 Marine Museum, Mystic, Conn. Mallory Building. Architect: Francis Day Rogers, New York, N. Y. Cost: $49,000.

1949 Morehead Planetarium, University of North Carolina, Chapel Hill, N. C. Wing of Morehead Building, a memorial. Architects: Eggers and Higgins, New York, N. Y. Cost of building: $2,500,000.

1949 Museum (history), Manassas National Battlefield Park, Va. Built in 1942. Architects: National Park Service. Cost: $58,000.

1949 Schleier Memorial, branch of Denver Art Museum, Denver, Colo. Remodeled factory. Architect of remodeling: Burnham Hoyt, Denver. Cost: $350,000.

1949 Thomas Gilcrease Foundation (art), Tulsa, Okla. Architect: Vernon Ellington, Muskogee, Okla. Cost: $225,000.

UNFINISHED (1949) OR PROJECTED

Akron Art Institute, Akron, Ohio. (Remodeling)

Boston Museum of Science, Boston, Mass.

Brooklyn Children's Museum, Brooklyn, New York, N. Y.

Charlotte Children's Nature Museums, Charlotte, N. C.

Detroit Historical Museum, Detroit, Mich.

Fort Wayne Art Museum, Fort Wayne, Ind.

Fort Worth Art Association, Fort Worth, Tex.

Fort Worth Children's Museum, Fort Worth, Tex.

Guggenheim Museum of Non-Objective Painting, New York, N. Y.

Illinois State Museum, Springfield, Ill.

Indiana State Museum, Indianapolis, Ind.

Junior Museum, San Francisco, Calif.

Milwaukee Public Museum, Milwaukee, Wis.

Museum, Texas Technological College, Lubbock, Tex.

Museum of International Folk Art, Santa Fe, N. Mex.

Oregon Museum of Science and Industry, Portland, Ore.

Rancho La Brea Museum, Los Angeles, Calif.

Rock Hill Children's Nature Museum, Rock Hill, S. C.

St. Petersburg Memorial Historical Society, St. Petersburg, Fla.

Seattle Museum of History and Industry, Seattle, Wash.

Tiel Sanford Memorial Building, Cherokee, Iowa.

Whitney Museum of American Art, New York, N. Y.

Many other buildings are projected more or less definitely. Also many additions and remodelings of existing buildings are under way or planned, as noted in items for the buildings concerned.

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